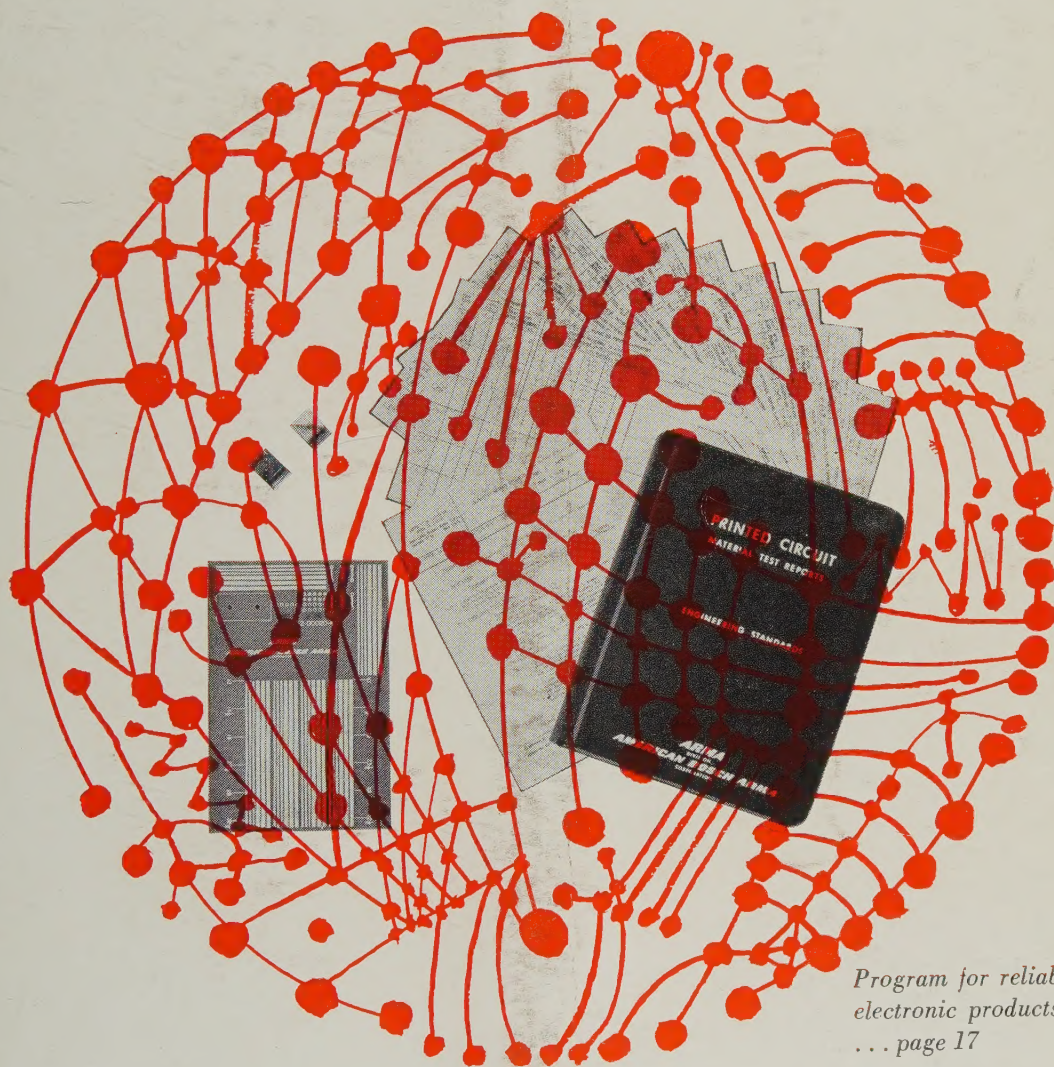


Insulation



Program for reliable
electronic products
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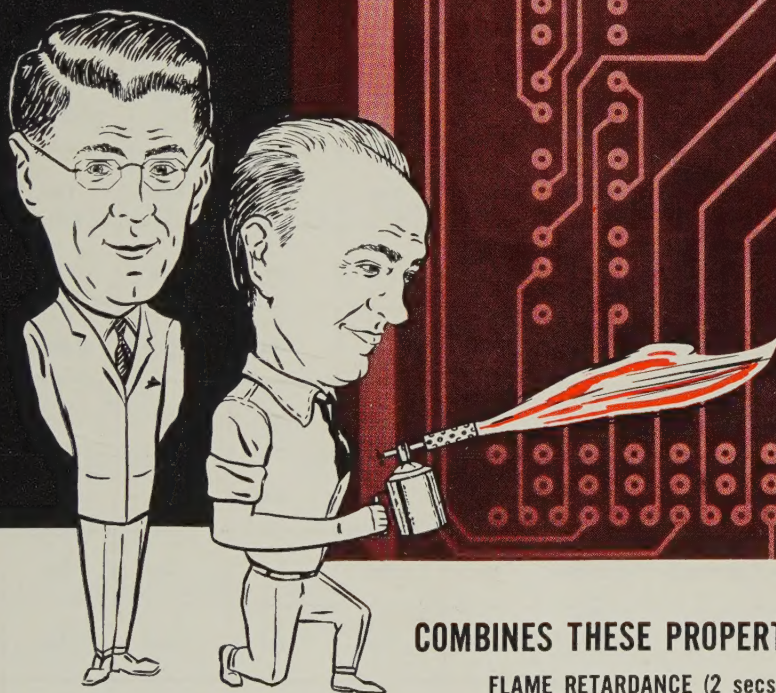
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For printed circuits where high reliability at operating temperatures of 130°C are required, MICO's new No. 6097 epoxy-glass LAMICOID sets new performance standards. Available with 1- or 2-oz. copper foil on one or both sides, it is readily machined and may be dip or float soldered.

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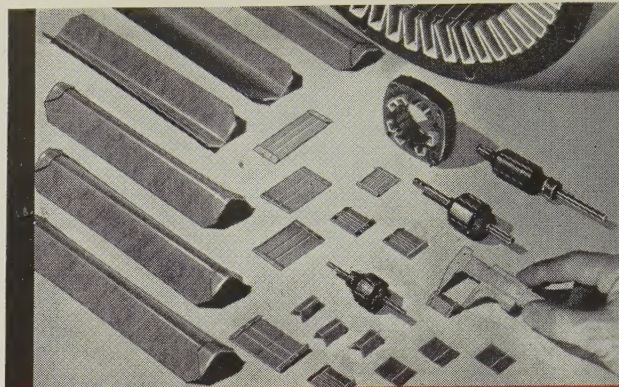
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Plain Flat (110) Plain Flat (110X) Scored Flat (120) Scored Flat (120X)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Single Cuffed Flat (210) Scored Single Cuffed Flat (220)	.025" max	Yes	Yes	Yes	No	Yes	No	Yes
Double Cuffed Flat (310) Scored Double Cuffed Flat (320)	.010" max	.010" max	.010" max	No	No	Yes	No	.011" max
Plain Flat Bottom (130)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Single Cuffed Flat Bottom (230)	.025" max	Yes	Yes	Yes	No	Yes	No	Yes
Double Cuffed Flat Bottom (330)	.010" max	.010" max	.010" max	No	No	Yes	No	.011" max
Plain Round Bottom (140)	Yes	Yes	No	Yes	Yes	No	No	No
Single Cuffed Round Bottom (240)	.025" max	Yes	No	Yes	No	No	No	No
Double Cuffed Round Bottom (340)	.010" max	.010" max	No	No	No	No	No	No
Contour (140XR)	Yes	No	Limited	No	No	No	No	No
Tab and Cuffed Shaded Pole (220TS)	Yes	No	Limited	No	No	Limited	No	No
Available Thicknesses, Inches	.005", .007", .010", .015", .020", .025", .031", .0625"	.005", .007", .010", .015", .020"	.006" through .021"	.010" through .028"	.004" to 1/8"	.00025" through .010"	.002" through .060"	.008" .009" .011"

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Insulation

For the Electrical and Electronic Industries

Lake Publishing Corporation, 311 East Park Ave., Libertyville, Illinois, August 1960

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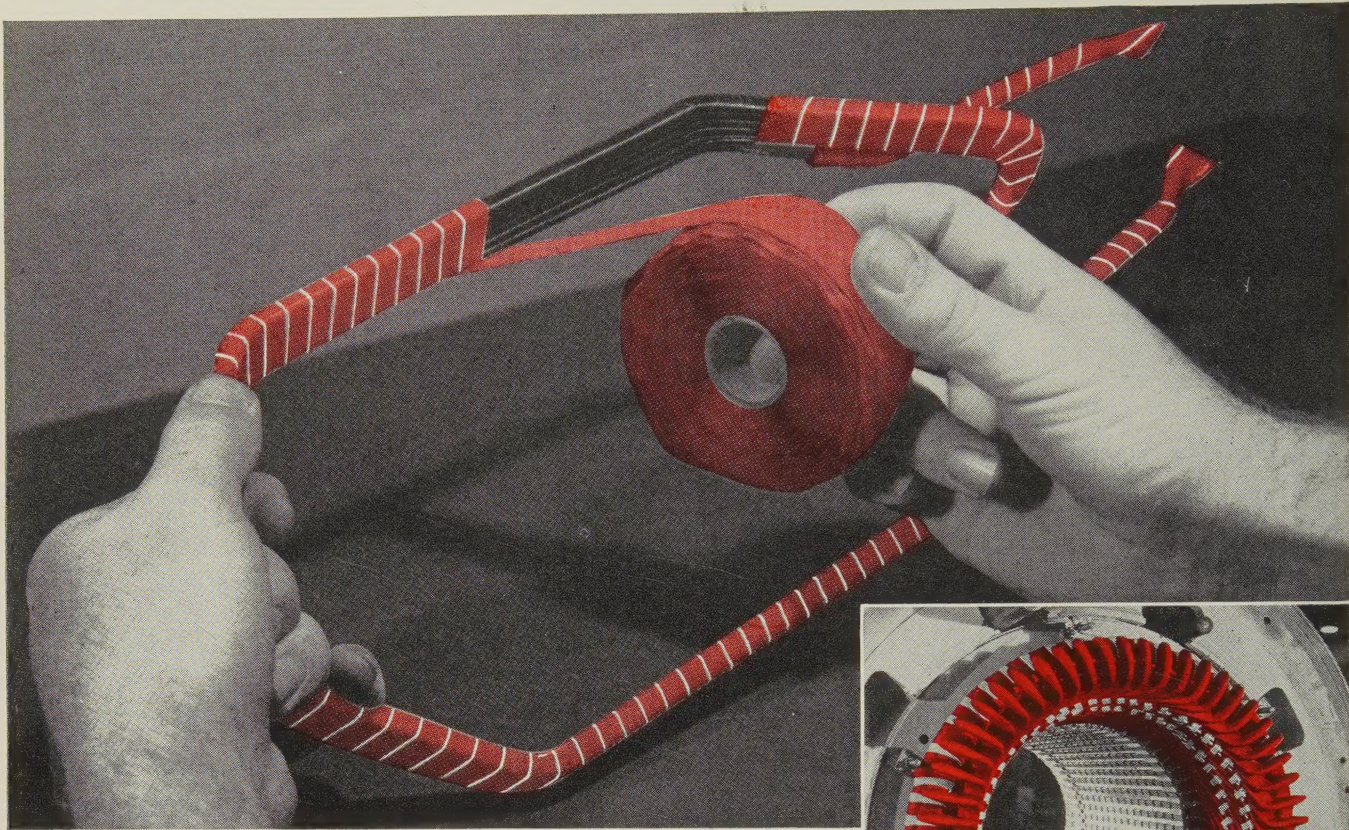
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Easier to Process...

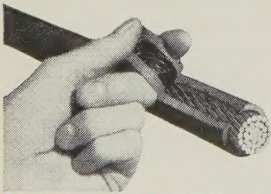


New Silicone Rubber Tape Cuts Application Costs 50 to 60%

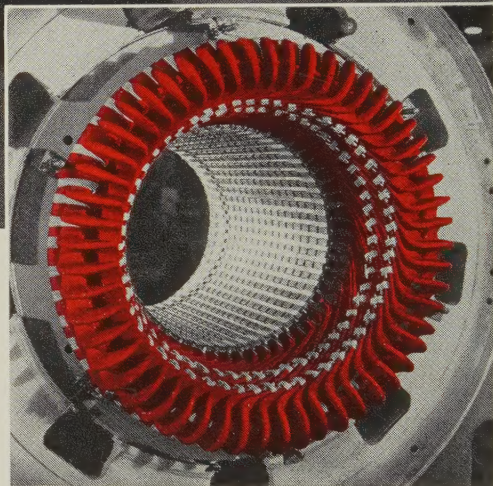
Now you can give motors, generators and other electrical equipment the superior protection of a silicone rubber insulation system at far less overall cost. The secret is triangular Guideline tape made with Silastic®, the Dow Corning silicone rubber.

Easy to apply, Guideline tape introduces new processing shortcuts. The end result: new low-cost protection for motors exposed to outdoor elements and industrial contaminants. Insulated with Silastic, open motors easily withstand the toughest environments. The reason is simple!

Silastic retains exceptional electrical and physical properties from -90 to 250 C, resists arcing, ozone, corona and weathering. Guideline tape produces a homogeneous, resilient insulation system unaffected by heat, cold, moisture, abrasives, many chemicals and corrosive atmospheres.



Tapes made from Silastic are also widely used for insulating cable and electrical equipment lead wires. The photo at left illustrates the homogeneous insulating structure and flexibility obtainable with tapes made from Silastic.



New Processing Shortcuts

Guideline tape's unique triangular construction and self-adhering properties result in these cost saving advantages:

One wrap only. A single wrap of Guideline triangular tape is all that's needed to produce the entire primary insulation wall thickness.

Self-adhering. The tape bonds to itself . . . requires no pasting. What's more, the tape's beveled edges overlap, producing a void-free insulation structure . . . requires no filling.

Easy to apply. A conspicuous center line makes it easy to achieve a precise half-lap construction of uniform thickness. Wrapped coils have a smooth surface and excellent appearance.

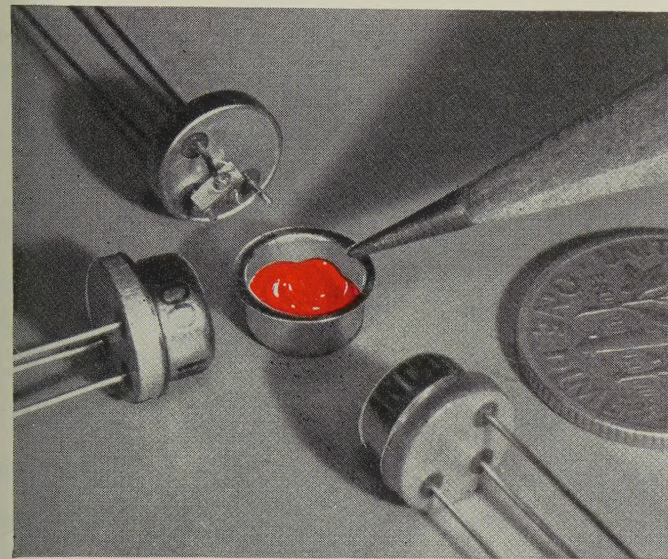
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Dow Corning

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Silicones Cut Costs



Boost Transistor Dependability

Dow Corning silicone compound is ideal for potting transistors. It protects from shock and vibration, conducts heat away rapidly. In addition, it reduces rejection rates by preventing metal splatter from reaching the transistor wafers when caps are welded in place. These silicone compounds don't melt, don't thicken, and retain their excellent dielectric properties from -40 to 210°C .

Transistor potting is but one of many uses for Dow Corning compounds. They seal out moisture at joints, on terminals, in many other applications . . . preventing arcs, shorts, flashovers, corrosion and contamination.

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Protect Against High Heat

Impregnating assemblies and components with Dow Corning 997 Varnish provides lasting protection. It's the final step, for example, in completing the insulation systems of motors and transformers designed for 180°C and 220°C insulation systems.

Performance-proved for continuous service at temperatures up to 250°C , 997 Varnish easily withstands the heat of overloads and severe duty cycling . . . is unaffected by high ambients and corrosive atmospheres . . . and offers better than 50 times the dielectric life of the best Class B impregnating varnishes.

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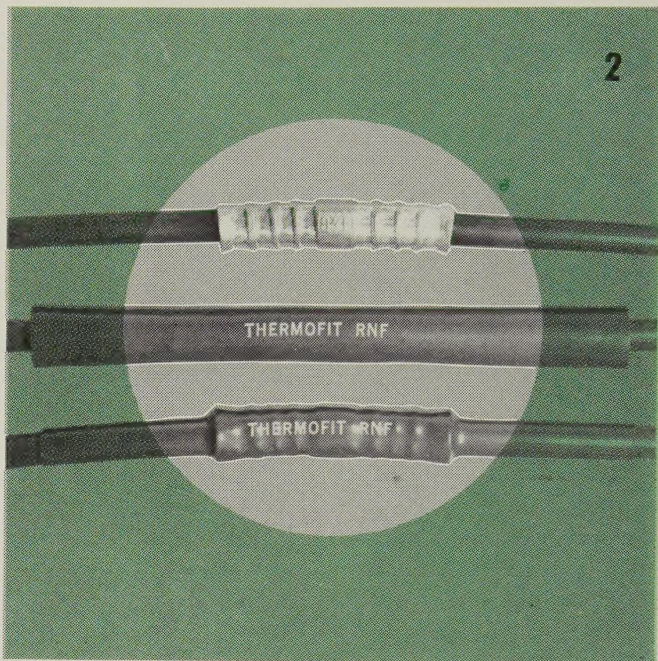
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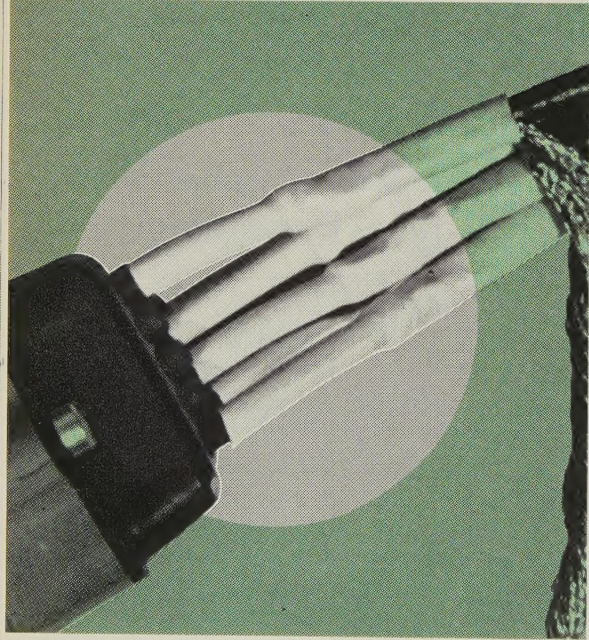
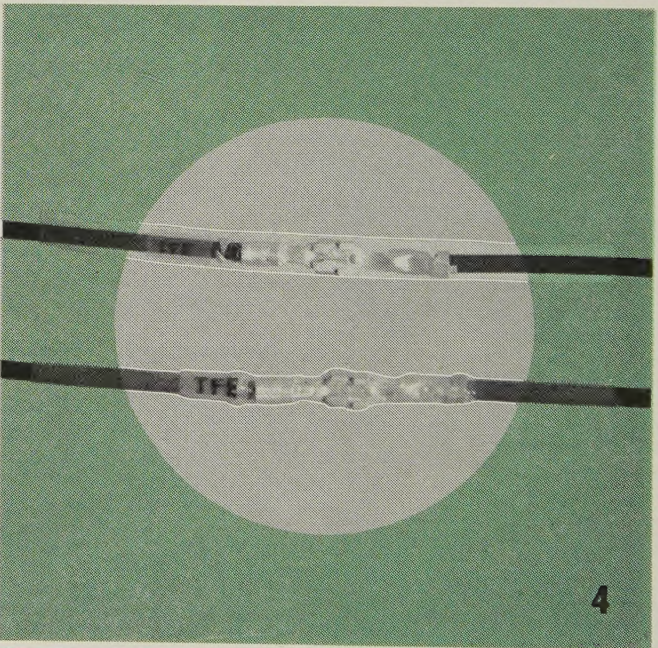
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4



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TFE A transparent, non-flammable, high-temperature sleeving embodying all characteristics of Teflon*.

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From the Editor

Opinions and Rambling Thoughts

Gone Is the Paper Clip and Match

For years and years, it seems we have received only two types of photos. One shows a tiny electronic part along with a huge paper clip to indicate that the part is subsubsubsub- or micromicromicro-miniature. The other type of photo accomplishes the same thing with a paper match. The captions for these photos usually tell us that 1-million of these parts can be crowded into a thimble. Now we don't know whether the caption writers are talking about a mighty big thimble or whether they really mean the regular-sized variety . . . but if it's the latter, we'd surely like to see those glib writers assemble those little old 1-million parts into something useful inside the thimble. We'd wager that their tongues are more nimble than their fingers.

But at last there is a refreshing note from out Pennsylvania way. Public relations man S. E. Madeline of Philco Corp. has done away with the trite paper clip, match, thimble, and similar tools of his trade. Yes, innovator Madeline has used a fly to



illustrate the size of two new micro-wave diodes. We think such creativity is wonderful but we must admit that our attention is drawn to the fly rather than the Philco products. Of course, we hope this doesn't herald a trend of insects and such . . . the next Philco competitor might use a flea and this would go on and on until one of the competitors finally was forced to use an amoeba . . . then the pages of *Insulation* would look like an advertisement for one of the

latest horror movies that star giant bugs.

Data Should Indicate Variability

A reader in Ohio writes about the constant inclination to present data in the form of maximum, minimum, and average. He points out that data would be much more valuable if the average, standard deviation, and number of samples were reported. All of us have undoubtedly been guilty of presenting data with no indication of variability, but here and now, we should make a resolution for the future that we will strive to indicate the extent of variability. There really is nothing more to say about the subject because our friend in Ohio is so right. We know what should be done . . . let's try to remember to do it.

EE's in Exclusive Group

If you are an electrical engineer you may or may not be glad to know that EE's who just graduated from Lehigh University commanded the top salary offers among the 520 seniors. Average starting salary for electrical engineers was \$540 a month compared to \$525 for the other branches of engineering taught at Lehigh. Accordingly, if, by chance, you are making less than \$540, you could at least try to be happy for the boys at Lehigh instead of griping about the disparity. And if you are making more than \$540, we suppose you should be thankful that you obtained your EE degree from another institution where they truly appreciated your talents.

European Insulation Report

Insulation is inaugurating a new editorial service for readers in this issue—the "European Insulation Report." This monthly feature, prepared by one of Europe's top insulation experts, will give American readers an insight into the insulation develop-

ments, trends, and practices of Europe. In addition to this regular feature, *Insulation* hopes to publish more technical articles by European authors in the future. At this time it might also be well to mention (for the benefit of both American and European prospective authors) that *Insulation* welcomes the opportunity to consider for possible publication all manuscripts and articles dealing with the field which have not appeared elsewhere.

Where is the Astronaut?

The Apex Reinforced Plastics Div. of White Sewing Machine Corp. sent in the photograph illustrated here. It seems that as a part of their space flight training, America's seven famed Project Mercury Astronauts are going to "fly" a weirdly fascinating and im-



posing device known as the Multiple Axis Space Test Inertia Facility. The only reason we publish this photograph of the facility is that it looks as confusing as its name sounds. It is so difficult to even find the astronaut in the photograph that we wonder what luck the astronauts will have in finding Mars or the Moon. Anyway, if you have a few moments to spare, you might try to find the astronaut—let us know if you are unsuccessful and we will reveal what we think is his location.

Insulation Application Conference Exhibit Booths Being Sold at Fast Pace

According to exhibit chairman A. E. Bohn, nearly half of the exhibit booths at the Insulation Application Conference were sold within a few days after an announcement mailing was made to potential exhibitors. The conference is being held December 5-8, 1960, at the Conrad Hilton Hotel, Chicago. Test instrument, production equipment, and insulation material producers who may wish to exhibit and have not received the announcement mailing may obtain copies by writing to A. E. Bohn, Dow Corning Corp., P. O. Box 549, Englewood Cliffs, N. J.

In addition to the exhibits, the conference will feature a complete technical program on insulation materials and applications, plant tours, a marketing meeting, and a conference banquet which will be addressed by men of national importance.

Polycarbonate Prices Down

With the first commercial-scale production of polycarbonate resins in this country now a reality, Mobay Products Co., a subsidiary of Mobay Chemical Co., has announced new, lower prices ranging from \$1.50 a pound to \$1.75 a pound for natural color resins. The price formerly was \$2.35 per pound minimum. Mobay, jointly owned by Farbenfabriken-Bayer AG of Germany and Monsanto Chemical Co., built its new polycarbonate plant in New Martinsville, W. Va. Present estimates place annual consumption of the material at a minimum of 20-million pounds per year by 1965.

Similar price reductions on polycarbonate resins have been announced by General Electric Company's Chemical Materials Department. Completion of the firm's multi-million pound manufacturing facility at Mount Vernon, Ind., is scheduled for the third quarter of this year.

G-E has also announced another price cut—for the second time in 10 months, the Silicone Products Department has reduced prices of silicone fluid and emulsion products by about four percent. The materials are used in the electrical, electronics, and plastics industries.

Navy Changes Cost Allocation For Insulation Qualification Tests

The Bureau of Ships has announced that it is changing the cost allocation of certain qualification tests when conducted in Government laboratories. The terminal date for tests in Government laboratories at Government expense is August 20, 1960. After that date, such tests will be at the manufacturer's expense. Specifications affected are as follows: MIL-I-21557 (Ships), Insulation Sleeving, Electrical, Flexible, Glass Fiber, Vinyl Treated; MIL-P-

19468, Plastic Rods, Polytetrafluoroethylene, Molded and Extruded; MIL-M-19833 (Ships), Molding Plastic and Molded Plastic Parts, Glass Fiber Filled, Diallyl Phthalate Resin; and Type D of MIL-I-16923, Insulating Compound, Electrical, Embedding. Copies of the specifications may be obtained from the Commanding Officer, Naval Supply Depot, 5801 Tabor Ave., Philadelphia 20, Attn: CDS.

Alcoa Consolidates Aluminum Strip Conductor Work at Rea Magnet Wire

Aluminum Company of America has announced that it is consolidating all its research, development, and sales efforts for aluminum sheet and foil strip electrical conductors at the plant of its subsidiary, Rea Magnet Wire Co. Inc., Fort Wayne, Ind. For the past few years, Alcoa, along with other aluminum firms, has done considerable work on aluminum strip conductors. This latest move puts the company in the position of being able to offer centralized research on both aluminum and copper conductors . . . and from a more unbiased standpoint.

First Commercial-Scale Production Of New Family of Epoxy Compounds

The first commercial-scale production of a new family of high-purity, light-stable epoxy compounds is now underway at the Institute, W. Va., plant of Union Carbide Chemicals Co. The new unit is producing epoxy plasticizers which reportedly are effective, low-cost stabilizers and plasticizers for vinyl chloride resins and can be used to improve vinyl electrical insulation products. The epoxides which are produced at the plant are said to be the only commercial-scale epoxides with cycloaliphatic structures that eliminate the light-unstable groups found in conventional epoxies which are based on epichlorhydrin and bisphenol A. Good electrical characteristics along with fast reactivity and compatibility with low-cost hardeners point to many electrical and electronic end uses. Look for more information in the New Products column of next month's issue.

Electrical Fires Cost \$136,800,000

Electrical fires destroy an average of more than \$136,800,000 worth of property annually in about 106,000 fires according to the National Fire Protection Association. There is a loss of about \$38,300,000 in nearly 30,000 fires caused by worn-out electrical equipment. Improper use of equipment accounts for 14,900 fires with a loss of \$19,155,000 and accidental electrical causes result in 12,800 fires with damages of more than \$16,400,000. Improper electrical equipment installation is responsible for losses of more than \$15,000,000 in about 11,700 fires.

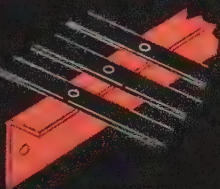
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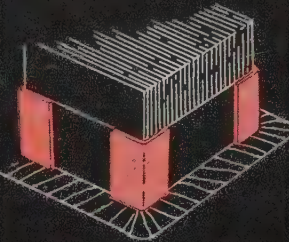
A NEW WAY
TO REDUCE
INSULATING
COSTS



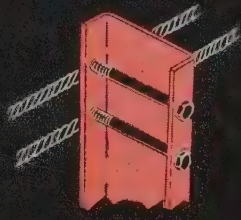
COMPONENT MOUNTING



BUS SUPPORT



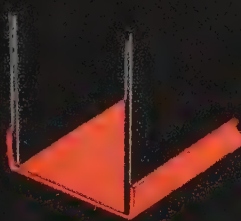
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CABLE SUPPORT



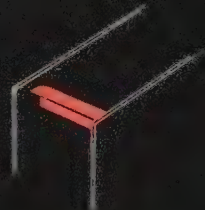
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BARRIER END



INSULATING OFFSET



INSULATING BRACING

Use versatile channel/angle stock for design flexibility, simplified assembly

The illustrations show typical ways in which Glastic insulating channel and angle stock can serve as product-improving replacements for heavier or more expensive forms—stand-off insulators, wood or insulated metal members.

The high strength stock is available off-the-shelf only from Glastic. It comes ready-to-use in 10 sizes, in widths to 9 $\frac{5}{8}$ " and lengths to 76". It can be easily fabricated to meet individual job requirements.

Glastic structural stock is molded of fiber glass

reinforced polyester and is engineered for use in equipment operating at Class B temperatures (130°C). It has UL-recognized flame retardance, and properties meet NEMA GPO-1 specifications.

Investigate the cost-saving possibilities of these easy-to-use insulating shapes in your applications . . .

SEND FOR COMPLETE DATA

"Insulating Channel and Angle Stock" Catalog contains application, engineering and price information. Companion catalog describes Glastic line of low cost insulators.



THE GLASTIC[®] CORPORATION

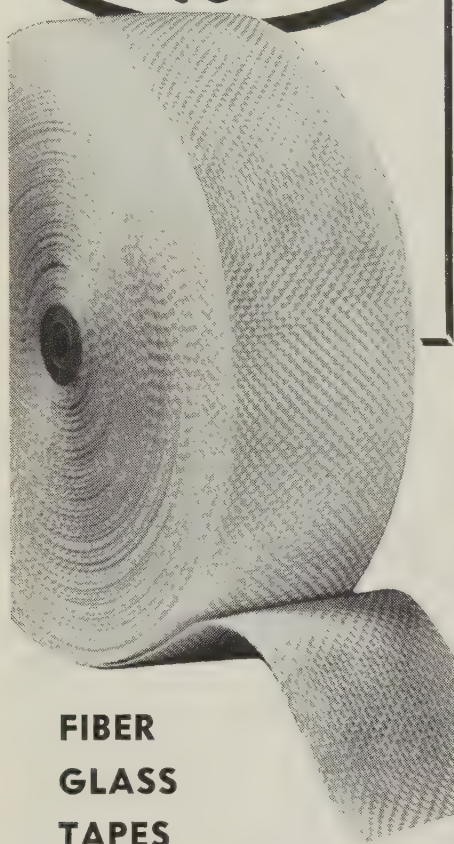
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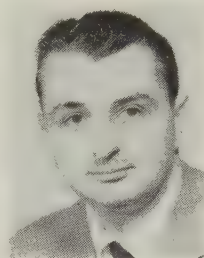
419 Walnut Street North Wales, Penna.

Print Ins. 7 on Reader Service Card

Insulation Forum

This regular monthly feature is built around a timely question concerning the electrical insulation field. Your suggestions for future questions and participation are invited. This month's question is:

In general, how do you evaluate insulation salesmen? Please discuss particular areas in which you think insulation salesmen are weak and/or strong.



T. L. Tasso

Head, Purchasing Section, Rheem Semiconductor Corp., Mountain View, Cal.

"In general, a salesman today must have not only the voice knowledge of his products but also the technical know-how to cover his statements.

"We evaluate insulation salesmen on their knowledge of their own product as well as that of their competitors—for we feel you have to know competition in order to sell properly.

"The fact that most sales today are of a technical nature has led to the failure of some men to gear themselves for the reverse situation of dealing with non-technical prospects. They have neglected to express their specialized knowledge in a layman's language. We feel that a combination of both the technical and non-technical approach to sales is a must."

C. R. Cooper

Purchasing Manager, Consolidated Avionics Corp., Westbury, N. Y.

"Insulation is a large and varied field. The salesmen who sell within this line can be broken into two categories: 1) The one who knows his

products very well but who tries to explain the complete line in detail, and 2) Pure salesmen who don't know their line at all but who exist on their toothpaste smile."

"Somewhere between exists the ideal situation, a salesman who knows psychology, his products, and can converse with enthusiasm. First find where the areas of potential use are. Then concentrate your talk on these areas only. Complete the presentation as quickly as possible, offering additional information whenever needed. Leave any pertinent literature and business card."



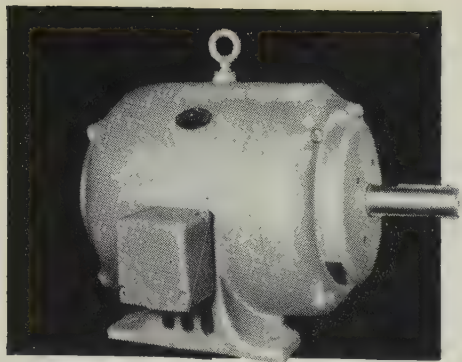
R. Ferdman

Purchasing Agent, Chalco Engineering Corp., Gardena, Cal.

"In order to evaluate insulation salesmen properly, we must bear in mind the scope of the insulation field. Therefore, when we discuss this specialized commodity we can only evaluate the sales people by the growth of insulation. My opinion of these people is very high, and I justly base this evaluation on past experience.

"Insulation is a field where new products, processes, and manufacturers are continually seeking the limelight. The insulation salesmen have shown a tremendous drive towards keeping pace with the changes and growth of this field.

"Salesmen possess the power to create satisfied customers and to date, the insulation field has many such customers. I am sure the future of insulation will continue to blossom through the efforts and initiative shown by the insulation salesmen."

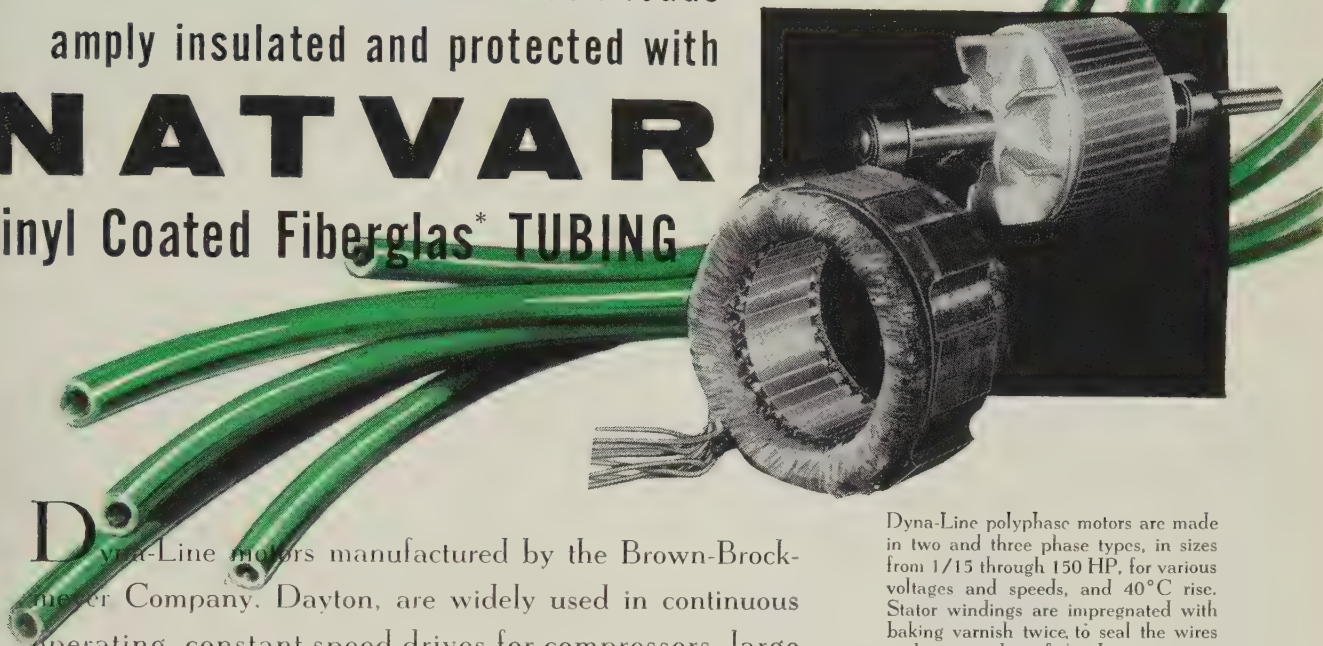


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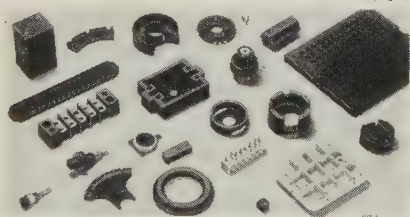
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Pixilated Patents

By Mike Rivise

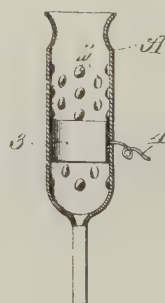
(Forty-fourth in a series of odd and interesting inventions in the electri-onics field from the files of the U. S. Patent Office.)

What must have been one of the first electrical milking machines was patented on Dec. 7, 1909, by Franz Max Berberich of Kiel, Germany. In both appearance and method of operation (vacuum suction), it seems to be quite similar to modern machines. However, it had certain refinements not seen on even the most recent models. For instance, the patent specified that the inside faces of the rubber teat cups should be roughened, or provided with protuberances 2, and provided with a metal contact 3 consisting of a ring or lining of metal such as tin foil. A wire 4 leading from a battery 5 or any other suitable means for generating a current of electricity is to be connected to the metal contact 3 and the other wire 6 contacts with some part of the cow's body so as to complete an electrical circuit.

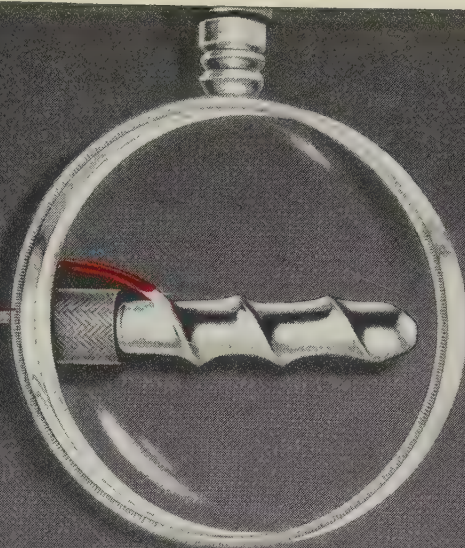
Despite what one might imagine, these features were not designed to torture the cow, nor to electrocute her before she could kick cold-handed milkers. At least, Berberich stated that he was trying to duplicate what he believed to be the action of a sucking calf. As he explained in the patent application, "It is well-known that the sucking of a calf is the most perfect manner of milking and produces a greater yield of milk than hand milking. This is due partly to the fact that by exertion of the muscles of the sucking calf light or weak currents of electricity are generated which are transmitted to the cow's udder and milk glands so that the milk flows freely and more abundantly, and partly to the fact that the action of the rough tongue of the calf on the teats on the cow's udder massages same and has a reflex action on the muscles of the cow which causes the milk to continue to flow freely."

Elaborating on the operation of the unit, he stated that, "The protuberances or roughened surfaces on the interior of the teat cups press on the teats which said cups surround when a vacuum is created in the tubes 1 and thus produce a reflex action on the muscles of the cow which causes the milk to continue to flow freely. Any preferred kind of teat cups can be used and the conducting wires 4 and 6 can contact with various parts of the cow's body as, for example, the udder, escutcheon, back, and milk veins."

What makes us suspicious of his motives is one of the final paragraphs in the patent application in which he states, "I prefer to subject the teats on the cow's udder to a pressing and sucking action at the same time the cow is electrified but, if desired, the cow can be electrified before the milking operation."



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European Insulation Report

Ed. Note: *The author of this monthly European report is a well-known insulation expert associated with a large European electrical manufacturer. Although it is necessary that his identity not be revealed at this time, correspondence may be exchanged with him by writing European Editor, Insulation, Box 270, Libertyville, Illinois.*

At the request of the editor of *Insulation*, I have agreed to report each month on various aspects of electrical/electronic insulation in Europe.

In spite of all the political, ethnological, and economic bonds between Europe and the United States, the development of industrial techniques in general and of insulation techniques in particular has followed different paths—primarily because of differing economic conditions.

The West European industrial states were, from the beginning of industrialization, adapted to export. This tendency was furthered enormously by the imperialistic policies of spheres of interest and colonies. The extremely chauvinistic national policies and interests, the continuous and (in comparison to the U.S. and Russia) slow growth of industry in Europe, the necessity of adaptation to all possible conditions, and the requirements of customers spread out all over the world naturally favored the production of single items rather than mass production. This has been especially true in the electrical industry. None of the West European industrial countries has an adequate internal market for its industrial products, so all have assigned a substantial portion of their production to export. This has an advantageous effect on the minds of engineers. They learn to think according to the necessities of export and acquire an understanding of developments and requirements in the whole world.

Under the pressure of economic prosperity, i.e. of rising wages and the increasing scarcity of design per-

sonnel, mass production is now gradually beginning to prevail. An irresistible standardization of customers' specifications is becoming apparent. This is being furthered by efforts to integrate the power supplies . . . and by the growing economic integration . . . of the various countries. The author regrets that a levelling of the political and social peculiarities in the countries of Europe is also taking place at the same time, and with it Western Europe is gradually losing one of its essential characteristics, namely individualism.

Until recently the costs of most apparatus and machines were determined primarily by the prices of the materials, with wages and salaries contributing only a small part. Therefore, no efforts were spared in order to save a few kilograms of material. A lot of trouble was taken to accurately determine actual stresses in order not to have any unnecessary over-dimensioning.

All this is in great contrast to the U.S. and especially to Russia. In the U.S., wages and salary requirements are decisive, a large number of special or new designs or adaptations are usually avoided, and mass production is favored. The customer has to adapt himself to the existing types whenever possible. Production is tuned to the gigantic U.S. market.

Russia still lives in isolation. Prices, wages, or the desires of a customer are hardly taken into consideration. Unified planning provides for unified requirements and regulates all questions ruthlessly without any regard to the balancing of the economy.

The study of European literature alone cannot give anyone not directly involved in the European insulation field a compact picture of the insulation activities and tendencies. European firms are very cautious with regard to releasing information to publications and jealously guard their experimental and test results. Hardly anything is published which has not

been thoroughly tested and used in production. The greatest caution is exercised especially on questions of insulation techniques. Neutral research institutes also fail to publish their results. There are no meetings in the American sense involving a moral obligation to publish papers and discussions. The little that appears must naturally be gathered from literature in at least four languages. A European academician does not find this situation to be an insurmountable obstacle, thanks to his knowledge of languages. My personal observations lead me to believe that the average European engineer is better informed about world literature than his opposite number in the U.S. The European insulation engineer can learn a lot about production techniques and also about the science of materials in the U.S.; on the other hand, the American engineer should know more about Europe, since for him, the problem of competition with European industry is becoming greater in many countries including his own.

I shall try to give you a true and complete picture of the happenings in the old continent by means of abstracts from articles, short commentaries, and, when possible, the original works of European experts. I shall endeavor to make use of the arguments and language of European engineers and, in particular, try to stress the varying interpretations. It is possible that a somewhat distorted picture may be formed by this approach, but every effort will be made to prevent this from happening, and to avoid forcing a specific point of view on the reader. I will welcome questions and suggestions from you, for this will surely help me introduce especially interesting subjects.

The European Editor



how **TEAMWORK** **PIONEERED** the use of **COLOR** in **PLASTIC JACKET CABLES**

Lenz Electric Manufacturing Co. felt the need in the electronics industry for color in plastic jacketed cables. In pioneering its development and use, Lenz Engineers called upon the Blane Corporation for a vinyl insulation material in various colors that would offer faster, easier, and permanent identification of cables before, during, and after installation.

Lenz specified that the material must facilitate connections between electronic units, make cables easier to locate and end forever confining cable jacket colors to the few dull and nondescript shades.

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This is how you can use ANILITE—One of the most evident applications is in low cost insulation for appliances, household wiring devices, and switches requiring UL approval. Because Anilite has excellent arc and flame resistance, it is a natural material for arc barriers, deflectors, and shields in switch-gear. Its ability to be permanently formed or shaped further increases its design possibilities.

These are the properties of ANILITE—The chart below compares some typical values of Anilite with those of a vulcanized fibre and a phenolic laminate. The properties (and price) of Anilite are between the two standard materials. The exception is arc resistance which is superior to the laminate.

	Commercial Grade Vulcanized Fibre	New Anilite	Paper Base Phenolic Laminate X-116-AP
Flexural Strength, psi	16,500	20,000	25,000
Impact Strength, ft.-lbs./in.	2.2	1.9	0.8
Dielectric Strength, volts/mil	200	335	700
Arc Resistance, ASTM, secs.	80	76	10
Water Absorption, 1/16" thk., % in 24 hours	63.0	25.0	4.0

For more information about ANILITE—Send for Technical Bulletin No. 304-101. Contact your nearby NVF Sales Office, or write us direct—Dept. D-8, Wilmington 99, Delaware.



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A Practical Program for Producing Reliable Electronic Products— A Printed Circuit Case History

By L. Krauss, Senior Engineer, and J. Monturo, Engineer, Engineering Standards, Arma Division, American Bosch Arma Corp., Garden City, N.Y.

Much has been said about the importance of and the need for reliability in modern military electronic gear. This article is concerned more with a practical approach to achieve these highly desirable goals, rather than with a statistical approach. This is not to say that statistics as applied to reliability are not important—actually, statistics are corollary—they will measure the level of reliability necessary or attained. The actual level of reliability attained depends on the controls exerted. And the level of reliability which is required dictates, to a large extent, the degree of control necessary.

In keeping with the foregoing, we must now decide the where, how, and when of controlling the product. The control approach and techniques described here have been applied to printed circuit boards. With some slight modifications the same control methods are applicable to other materials and processes.

The major control areas are design standards, material specifications, suppliers, incoming inspection, and in-plant processing. The first of these control areas has been discussed in detail in a previous publication*.

Accurate Material Specifications

The need for accurate material specifications and the basic criteria to be included were presented in the same publication. This need was met by the preparation and use of a carefully detailed printed circuit board procurement specification, which consisted of:

a. Base laminate characteristics.

- b. Base laminate qualification tests.
- c. Base laminate acceptance tests.
- d. Base laminate periodic control tests.
- e. Fabricated part characteristics.
- f. Fabricated part qualification tests.
- g. Fabricated part acceptance tests.
- h. Fabricated part periodic control tests.

Base Laminate Characteristics

This section of the specification defines the parameters of the material with accurate statements and corroborative tests. The requirements, such as bond strength, heat resistance, electrical properties, etc., are set forth in this section. A typical requirement extracted from the present specification is as follows:

“3.15 *Flexural Strength* — When tested as specified in 4.5.10, the flexural strength in the lengthwise and crosswise directions shall not be less than the values specified in the specification sheet.”

It is to be noted that this is a complete statement; that is, there is a requirement and a method of determining compliance to the requirement. Too often one sees a characteristic defined as follows:

“*Flexural Strength* — 55,000 lbs. per sq. in.” The inadequacy in this instance is obvious. How do you conduct the test? What are the environmental conditions? What is the sample specimen, and from what source is it obtained? In other instances the inadequacy may be more subtle.

It must be pointed out that in those instances where a specification merely transcribes experience and where a wealth of data exists, the task is relatively simple. It is the “state of the art” type of item that requires the

skill of anticipating accuracy, developing test procedures, coordinating activities, and part specification follow-up and verification.

Base Laminate Qualification Tests

The base laminate qualification tests consist of all the tests that are specifically related to the base material. Such criteria as platings and undercutting would not be considered in this section. The fact that a material has been tested and placed upon a qualified products list *signifies only that at one time* the manufacturer made a product that met specification requirements. Inclusion on a qualified products list does not in any way relieve the manufacturer of his contractual obligation to deliver items meeting *all* specification requirements. A qualification test may be considered as a screening device because consideration is only given to products that meet the qualification requirements.

Qualification criteria must be established on the basis of the total environment that the item must withstand without any degradation. These tests must include any processing environment in addition to the natural environments (humidity, salt spray, vibration, etc.). For instance, all printed circuit boards used at Arma are subject to a flux removal operation in a solvent bath. This solvent bath is a processing environment and could affect the bond strength; therefore, a solvent resistance test that is similar to the shop procedure is specified as a qualification test for the base material.

In our case, qualification tests for printed circuit base materials are the responsibility of the fabricator since

*Arma Engineering, Volume 2, No. 6, Pg. 26 of “Reliability Through Standardization of Printed Circuits.”

Arma does not presently manufacture printed circuit boards. It would place us in a precarious position to simply specify the base material that the fabricator must use in his product. The implications are fairly obvious.

It is incumbent on the supplier that test samples for qualification tests be representative of his *repeatable* production for the requirements specified.

Base Laminate Acceptance Tests

Acceptance tests are those which are performed to determine the acceptability of qualified production items. These tests are carefully selected from the qualification test list on the basis of their ability to control the product. Acceptance tests are usually comprised of 100% inspection and sampling inspection tests to a determined *acceptable quality level (AQL)*.

For printed circuit base materials, each sheet is tested at the source for hot solder resistance after conditioning the specimen for 96 hours at 90% RH and 35°C (C/96/35/90). This is 100% inspection and is performed because of the critical nature of the de-

fect and the susceptibility of the material to this defect. Visual inspection (dimensions, surface appearance, warp, twist, etc.) is also on a 100% sheet basis.

Base laminate acceptance tests could be considered the backbone of the specification since it is at this stage of the manufacturing cycle that the material assumes a significant cost. Poor material funneled into production at this stage at a material cost of \$3 per panel costs \$60 per panel as a rejected part on which processing has been completed.

Base Laminate Periodic Control Tests

Periodic control tests consist of the qualification tests that are not performed as acceptance tests. These tests are either performed on a periodic calendar basis or on a material consumption basis. Periodic control tests usually consist of checking secondary characteristics—or those characteristics that have been relegated to this category due to consistent positive acceptance test data. Periodic control tests coupled with acceptance tests in essence constitute requalification.

Fabricated Part Characteristics

This section defines the characteristics as applied to the finished items. Bond strength, plating thickness, insulation resistance, solderability, and other end item criteria are described with suitable methods of test.

Fabricated Part Qualification Tests

Fabricated part qualification tests determine the *ability* of a fabricator to produce items to specification requirements. As such, it is intended that the tests be capable of weeding out inferior or marginal fabricators. The tests are performed by Arma on standard test specimens fabricated from qualified laminate material by the prospective fabricator. Since Arma is a buyer of printed circuit boards, and tests are extremely important and must be performed with utmost precision.

Of necessity, the tests are based on maxima rather than on minima. It is vital that safety factors be employed to guard against rejects during subsequent assembly.

Fabricated Part Acceptance Tests

Once a fabricator has been qualified, it is the acceptance tests that determine the accuracy of vendor selection. It is the acceptance tests that determine whether a finished item is to be accepted or rejected. Therefore, it is mandatory that acceptance characteristics be clearly stated without possible misinterpretation. Vague generalities, which always lead to subsequent discussion and compromise, must be avoided.

Vendor perusal and approval prior to actual use is required for minimum rejects and revisions. Due to a lack of understanding of the nature of the product, many pressures are exerted to minimize requirements. An explanation of the philosophy and intent of the specification tempers and, in most instances, converts the opposition.

Fabricated Part Periodic Control Tests

Periodic control tests consist of the balance of qualification tests that are not performed as acceptance tests.

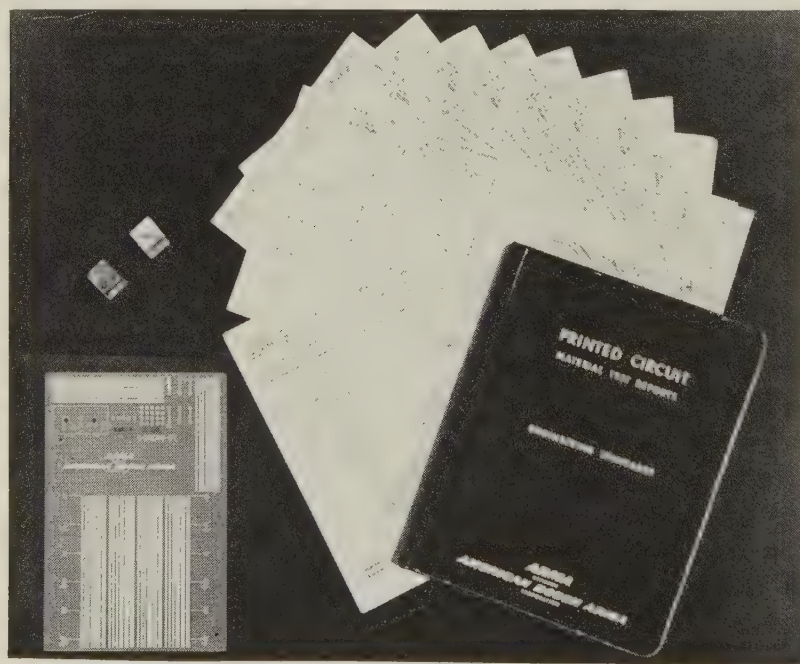


Figure 1, quality control data reporting sheets, inspection bulletin, standard test pattern, and specimens. The data sheets provide a permanent record of test data and are used to prepare process control charts and for vendor evaluation. The standard test pattern (shown at left with two metallurgically mounted specimens above it) is used to evaluate the fabricator's processing. It is processed simultaneously with production boards and is coded for each lot.

These tests, conducted by Arma and the fabricators, serve to control the processing parameters.

The stringent controls imposed upon the printed circuit boards were exercised under the closest scrutiny for the past 18 months. Data has been obtained from many sources: the laminator, the fabricator, and Arma's quality control section. The accumulated data were statistically analyzed for a determination of the relative importance of each control area. The results of this analysis indicated that many areas previously considered critical were so well controlled that they could safely be relegated to a lower inspection level. For example, flexural strength, volume resistivity, heat resistance, and solvent resistance, which were previously considered to be critical control points and which were therefore placed on a 100% test basis, are now on a periodic control basis.

It should be repeated that this action was taken as a result of a statistical study of accumulated data. Certain tests such as bond strength after dip soldering and insulation resistance before and after moisture cycling have been retained on a tight inspection level because they help to indicate material integrity and the material's ability to withstand assembly operations.

The establishment of controls, the costs of testing, and close surveillance could be expected to have had a pronounced effect on the cost of the printed circuit board. Initially, this was the case as a result of the lack of familiarity by everyone (laminator, fabricator, Arma) with the controls imposed. The resulting cost increases to Arma were in the neighborhood of 100%. However, the fabricators were willing to hedge against this unfamiliarity by basing part of their price on a reject rate. This hedge took the form of a renegotiable contract.

The results of the program have been most gratifying. Rejects by Arma to the fabricator have been negligible. In one case, only 8 rejects were recorded out of a quantity of 1500 pieces shipped at various intervals. The price of the printed circuit board has dropped to a reasonable competi-

tive level. Many of the tests have been adopted by the laminators and fabricators and are presently part of their own quality control procedure. Disputes over test data have been minimized, and test data corroboration has been excellent due to the standardized test methods. The net result has been an overall cost saving with continued high quality.

Qualified Suppliers

The term "qualified supplier," while seemingly explicit, on closer inspection has a number of important implications. Explicitly the term would describe the supplier of a qualified product, but where product consistency, reproducibility, and reliability are the customer's prime considerations, the implied meanings of the term assume primary value.

The first of the term's implications is that the supplier has demonstrated his technical capability. His personnel in all areas of engineering and manufacturing must show a complete familiarity with his product. They exhibit a professional attitude toward their business. They take pride in their product, have an interest in advancing the state of the art, and take a realistic attitude toward the customer's problems.

The supplier must maintain and use appropriate research and development facilities. These facilities must be adequate to support work in the advancement of the state of the art, in the solution of manufacturing problems, and in the determination of control factors. Quality control should be implemented by appropriate test facilities adequately staffed with qualified personnel. Systems, procedures, organizational charts, and check point charts (figure 1) should be available to demonstrate the control philosophy in use.

Manufacturing facilities should be commensurate with the total effort. Tooling should be modern and properly maintained. A view to automated or semi-automated machinery should be in evidence. Cleanliness and layout should be conducive to efficient output, good workmanship, and appropriate controls. Product control levels should be physically separated in

those plants where different products are co-produced. High reliability products for essential military applications and commercial products should not be manufactured on the same physical plant equipment or by the same personnel.

The second implication of the term "qualified supplier" is that he has demonstrated a willingness and ability to support a product reliability program. This should be done through his ability to produce appropriate quality control and inspection records (figure 2). He must be able to show process control at any point of manufacture. He must maintain and service internal reject records (figure 3) and be prepared to show a conscious effort to reduce the reject level. He must be aware of, and conversant with, the customers quality requirements, and he must be prepared to implement and reinforce these requirements in all ways.

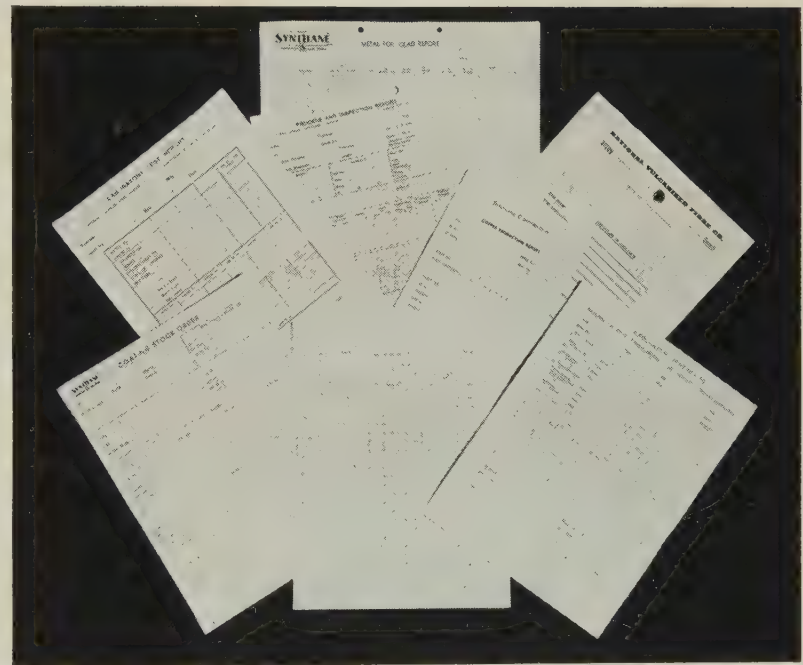
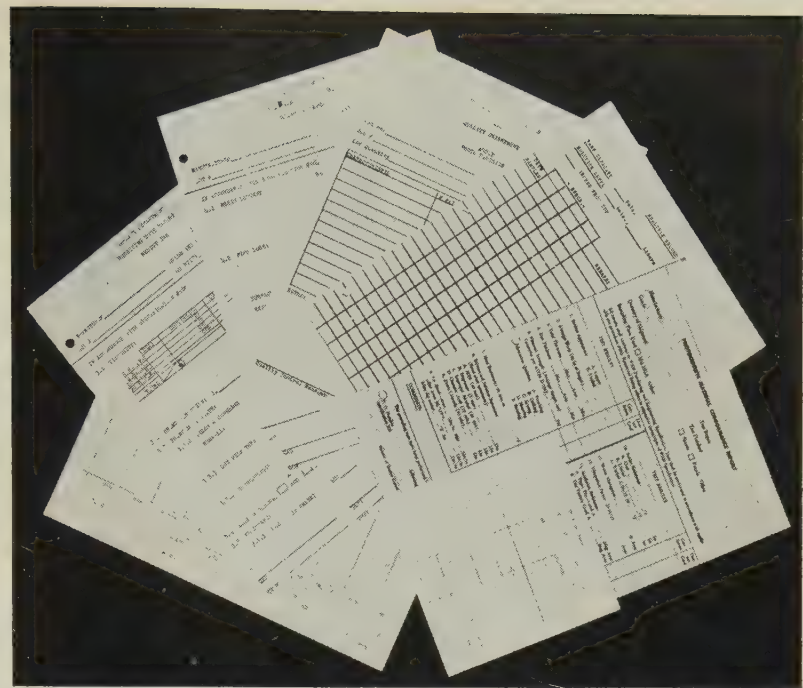
To illustrate the importance of this factor in determining qualified or unqualified suppliers, the following excerpts were made from a supplier's response to Arma's request to him for qualification test data (parentheses are ours). "We do not have either of these (applicable MIL and Federal Specifications) in our files and as of this moment have been unable to obtain copies. . . . For lack of these specifications to study and for other reasons we would have to say that as of now we cannot submit the requested test data. Suggested (data) Forms A (qual. to MIL Spec.) and B (government certified qualification test to Arma's drawing) are out of the question because we know of no military specifications for this (material) and Form B could not be submitted because we do not have a resident government inspector and if we sent for one of the local inspectors he would be unable to perform the necessary tests since we do not have the specifications on hand and undoubtedly do not have all of the necessary testing equipment. . . . You can therefore readily see the dilemma with which we are faced. We want very much to cooperate with you and we certainly want the opportunity of supplying our (material) when you have require-

much effort is needed to determine this. In this regard, we are considering the allied efforts of engineering, quality control, and inspection.

Those familiar with inspection control appreciate the dangers of over-inspection. Personnel requirements and product costs increase in direct proportion to inspection levels and the number of characteristics of the number of items inspected. Once again, only the most concerted effort and careful analysis can prevent over-inspection. Before discussing the steps taken to effectively ensure adequate inspection controls, we should establish a perspective in relation to the range of the items involved. The electronic industry materials field is very broad. The actual number of different materials and material applications in a single electronic system can often run to almost 500.

The first effort to impose controllability within reasonable limits on the material is made at the time the material is first specified. This is accomplished by describing the material by its salient features and a brief statement of engineering requirements. Both the requirement statement and the characteristic description can and should be implemented by reference to testing methods which are preferably industry standards and which in no case are less than acceptable to the supplier and user. Standard tests should require no more than reference to the test document from which they were drawn, such as the ASTM test standards and the Federal and Military test and material specifications. Non-standard tests and modified standard tests should be fully documented and compiled into a ready reference for the inspection function. It is of the utmost importance that the material or process be described as briefly, simply, and completely as possible. This of course will mean, and has meant, a careful study of the design limits and application criteria. It is equally as important to obtain the widest application for the fewest materials.

The final effort in this phase of control is the establishment of appropriate acceptance quality levels and sampling plans. The former describe



Figures 4A and 4B, various quality control check sheets used by fabricators and laminators at various stages in the manufacturing operation. Forms courtesy of National Vulcanized Fibre Co., Synthane Corp., and Photocircuits Corp.

quality control's estimate of the critical nature of a material and its application, and the latter refer to the rate at which tests will be conducted.

In-Plant Processing

In-plant processing areas must also be controlled to ensure a highly reliable end product. Such processes as fluxing, soldering, cleaning, and pro-

TECTIVE COATING must be kept under close scrutiny. The selection of materials is made on the basis of laboratory data and experience.

In-plant process controls are also required to ensure adherence to specification requirements. Many of the processes are state of the art and require subjective criteria for controls. Soldering is typical of this type of

process. In soldering, variations in pattern configuration, material thickness, component density, and thermal sensitivity of components are compensated for by means of variations in dwell time and/or bath temperature. The control criteria are visible joint characteristics that have been found by test to be indicative of sound joint structure.

In view of the difficulty of controlling the state of the art processes, machine application is utilized to the maximum extent to obtain end product reliability. Fluxing, dip soldering, flux removal, lead forming, and protective coatings are mechanized, thereby reducing and further controlling human variables. In all of the processes material characteristics that influence process variations, such as viscosity, solids content, cure time, chemical composition (solder), and moisture content, are continuously controlled to established values, thereby improving the reproducibility and reliability of the process. While the foregoing has been aimed at providing a piece of hardware with the high-

est functional reliability, steps must now be taken to maintain this high degree of functional reliability throughout service life conditions.

This is accomplished through the use of encapsulants and coatings which provide moisture and handling protection and vibration damping characteristics. The coatings used are predominantly the epoxy type modified for the particular application. The resultant coating is conformal rather than cast or superficially applied. Since this is the last step in a series of highly controlled processes, its importance cannot be overstressed. Discrepancies at this stage of manufacturing can be economically disastrous.

Of vital importance to any control effort, though often overlooked, are the educational aspects. Each participant must be made aware of his contribution to the overall program. Skills must be developed and talents allocated to the appropriate area. The importance of each manufacturing operation must be clearly understood by the operator, and he must be made

aware of the relationship of his operation to all other operations. He must be continually impressed with the desirability of good workmanship, careful handling, adherence to detail, neatness, etc., and above all, the necessity of questioning the slightest variation from the desired standards.

It is equally as important that quality control personnel be familiar with the importance of each control and inspection station and the relationships between them. In addition, they must establish the criteria for good workmanship, careful handling, neatness, and specification interpretation, and they must disseminate collected information to responsible activities. They must be made aware of the need for quick action in order that a defect be contained and remedied.

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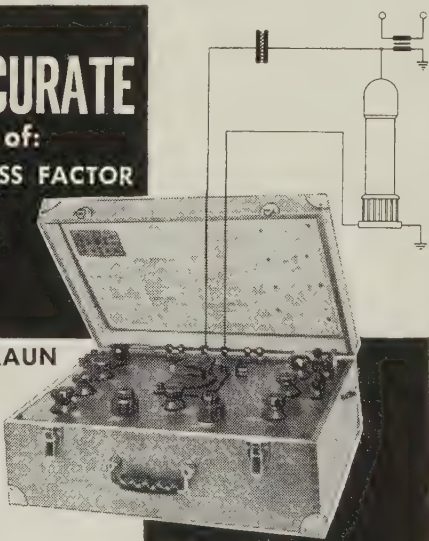
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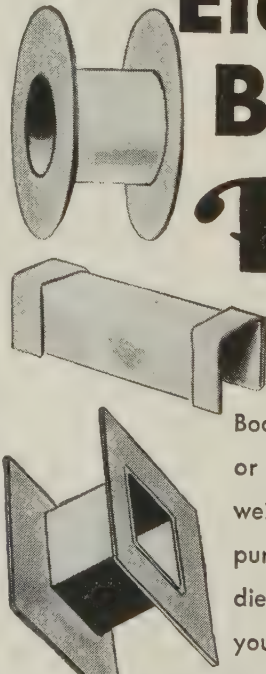
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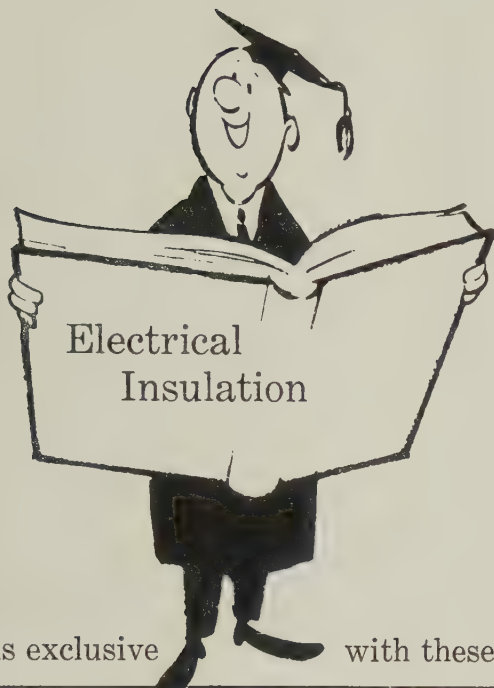
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Insulation, August, 1960 23

Review of Insulation Papers Presented At AIEE Summer General Meeting

Announcement of 1960-61 officers, presentation of the Lamme Medal, and a number of papers dealing with insulation were among the highlights of the summer general meeting of the American Institute of Electrical Engineers, held a month ago in Atlantic City, N.J.

Clarence H. Linder, vice president, General Electric Co., is the new AIEE president. New vice presidents are Clair E. Gaylord, New York Telephone Co.; Robert T. Weil, Jr., Manhattan College; Fred W. Bush, Allis-Chalmers Manufacturing Co.; Sim C. Wright, Southwestern Bell Telephone Co.; Henry A. Carlberg, Hanford Works, General Electric Co.; Adolph W. Rauth, Consumers Power Co.; Walter Criley, Vanderbilt Univ.; and Paul G. Wallace, Texas Power & Light Co. William R. Clark, Leeds and Northrup Co., was elected treasurer.

Lee A. Kilgore, director of engineering, Westinghouse Electric Co., was awarded the Lamme Gold Medal at the meeting for "meritorious achievement in the design of electrical machines."

Some of the insulation papers which were presented at the meeting are briefly reviewed here.

A New and Improved Heat-Stabilized Insulation

By J. G. Ford, A. M. Lockie, and M. G. Leonard, Westinghouse Electric Corp.

In a previous paper, the stabilization of cellulosic insulation by certain amine compounds was described, and the effect of these additives on materials, models, and complete transformers were discussed. This work led to the "Insuldur" insulation system for distribution and power transformers with significantly increased thermal overload capacity.

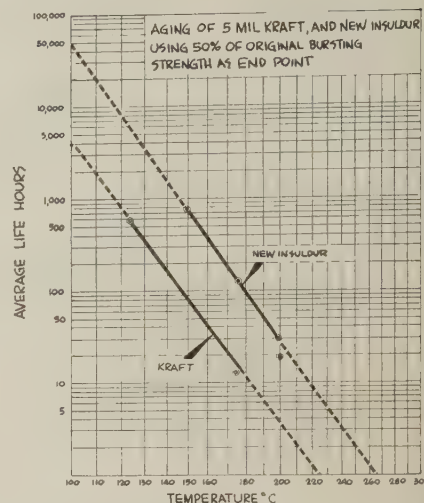
Since the introduction of the original system, many additional stabilizing materials have been investigated, resulting in the development of a new system which provides further im-

provement in thermal endurance by a factor of at least two. The new system also utilizes a different method of applying the stabilizers. Originally, the solid insulation was protected by amine salts dissolved in the transformer oil. Now, the stabilizers are incorporated as part of the solid insulation. This paper describes the test program which confirms the improvement brought about by the new system.

Generally, a transformerette test was used as a screening test. In this test, the insulation is placed in a sealed steel container in oil along with copper and electrical steel. The material under test is used as layer insulation in a small coil simulating a high-voltage winding of a distribution transformer. The winding is heated for one week, to an average copper temperature of 140°C, by circulating current. At the end of this time, the cellulose layer insulation, the turn insulation, and the oil are examined to determine the degree of deterioration. The wire insulation and oil are checked by the usual test methods. Cellulosic layer insulation is generally tested for bursting strength, but tensile and flex tests also have been made.

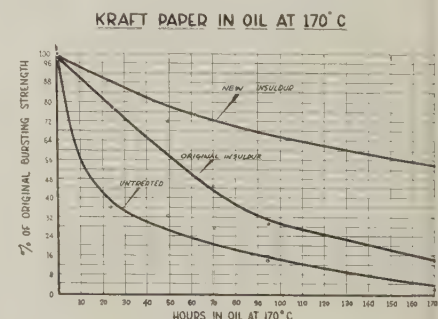
While many compounds and mixtures have been evaluated, this paper was restricted to a discussion of the characteristics of a mixture of water soluble compounds consisting of melamine, dicyandiamide, and polyacrylamide, in the proportion to give maximum inhibiting effect with the least amount of additive.

The figure shows the relative thermal stability of plain kraft paper and the new Insuldur paper when aged in oil in sealed containers at various temperatures. Mullens bursting strength is used as the measure of deterioration. If we examine the points corresponding to 100 hours life on the curves, we find that the new stabilized paper will withstand temperatures about 30°C higher than those for untreated kraft.

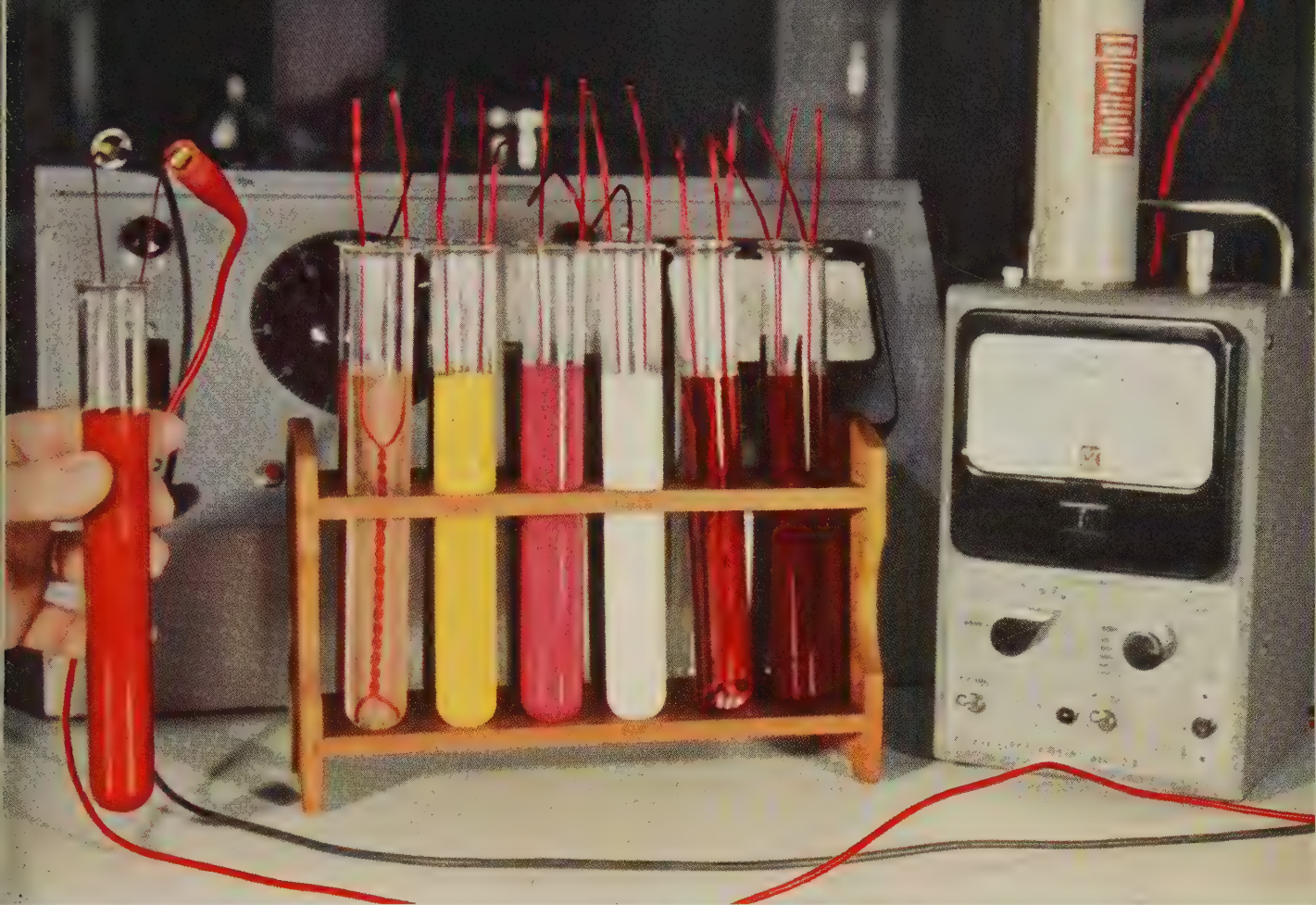


In a comparison of the relative rates of deterioration of 1/8" thick kraft and stabilized pressboard when aged in oil with copper and iron present, using tensile strength as the criterion of aging, the average difference is 27.5°C as compared to 30°C when Mullens bursting strength is used. However, the tensile strength curves tend to converge more at the higher temperatures than the bursting strength curves. Assuming halving of life for each 8°C rise in temperature, these differences indicate that the life of kraft paper or pressboard in oil-filled transformers can be increased as much as eight times by incorporation of the new stabilizers.

The next figure compares the deterioration of untreated kraft paper with that of kraft treated with the



original and the new Insuldur stabilizers, using bursting strength as the criterion of aging. Taking the 50% strength retention point, it is shown that regular kraft paper gives 13 hours, the original Insuldur 67 hours, and the new Insuldur, 200 hours.



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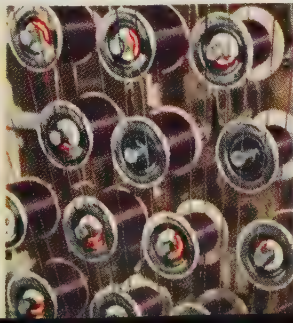
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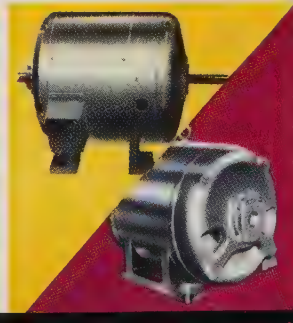
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Dimensional measurements were made of insulation with and without stabilizers when aged in oil with practical exclusion of air. This represents conditions in a modern transformer. Stacks of about 4" of 1/8" pressboard were spring-loaded to a total of 50 lbs., dried at 110°C, and accurate measurements of stack height were made. After 52 days, the shrinkage of the unstabilized board was approximately twice that of the stabilized board. At the end of 52 days, the fixture used for regular kraft board was covered with a slimy, black deposit whereas the stabilized board fixture was quite clean. A check showed that the water content of the oil was 6½ times as great and the oil acidity slightly over 6 times as great with the regular board as with the stabilized board. It was also noted that when the containers were cooled and samples removed for checking, the gas evolution from the unstabilized material was much greater. Tests indicate that the dielectric strength, either 60 cycle or impulse, of pressboard is not materially affected by the introduction of the stabilizing material.

Tests in air of the stabilized insulation have not been very extensive but it is definitely indicated that the thermal life of cellulose is improved. While appreciable stabilization is obtained, the improvement is not as good as is obtained in oil. Perhaps the stabilizers are not as effective where oxygen is present in appreciable quantities as in air.

Full-sized distribution transformers, with and without the stabilizer, were loaded to produce an average winding temperature of 140°C, which was maintained for one week. Following this aging, the transformers were torn down, and the bursting strength of the layer insulation was measured. The average bursting strength of the stabilized paper was 70.1 psi, while that of the unstabilized paper was only 34.0 psi, a ratio of better than 2:1.

Full-sized transformers, with and without stabilizer, were also put on functional life tests at 220°C hot-spot temperature, following the procedure adopted by the AIEE Sub-group on Thermal Evaluation of Oil-Immersed Transformers. These tests are not yet

complete, but the results to date are illuminating. (a) *Half* of the units without stabilizer failed in less than 1000 hours at temperature. (b) *None* of the units with stabilizer failed in less than 2000 hours at temperature.

Temperature Capabilities of a Modern Transformer Insulation System

By W. H. Mutschler, Jr., and W. C. Farneth, Allis-Chalmers Manufacturing Co.

This paper presented information on the effect of various materials on the chemical reactions present in oil filled transformers as determined by laboratory tests and conservative estimates of the life expectancy.

Several years ago, a series of laboratory tests was completed to determine the chemical interaction of a number of combinations of materials at moderate temperatures. The purpose of these tests was to determine what combinations of material would produce a minimized chemical reaction rate thereby obtaining a more reliable system. This investigation included tests on 9 wire enamels, 17 commercial coating resins, 9 bonding resins, and kraft and manila paper from various sources. Combinations of these materials were tested with copper and steel in proportions typical of distribution transformer construction. Some of the combinations incorporated adsorbents in the system to study their effect on the products of decomposition.

A number of characteristics of materials were measured such as dissipation factor, color, dielectric strength, acidity, IFT. Of all of these, the acidity of the oil is a particularly sensitive measurement of system stability since acids accelerate chemical degradation. The IFT of the oil is another indicator of stability.

For acidity and IFT, the test specimens consisted of 20 glass microscope slides coated with a film 15 mils thick which constituted 0.5 percent by weight of the oil in which the resin was to be aged. The coatings were cured as recommended by the supplier, vacuum dried, purged with dry nitrogen, sealed, and aged six months at a constant temperature of 105°C.

The acidity of the oil increased

very rapidly for all coatings and the IFT decreased correspondingly. Of all the resins tested, an epoxy had the least effect on the acidity while the more commonly used alkyd had the greatest effect. However, all of the tests indicated significant chemical change. Since these resins are typical of those used on coated layer insulation and since these tests indicated that it would be desirable to eliminate these resins from transformers, it was necessary to develop other means for obtaining the necessary short circuit strength in the units. This was done by improving the mechanical bracing as well as by improving the distribution of turns in the high voltage winding.

Many combinations of paper, steel, wire, oil, and water were aged for one year at 105°C, one year at 120°C and three months at 135°C. From the results of these tests it was concluded:

1. That conventional insulating oil will deteriorate even though no other organic materials are interacting with it.

2. That synthetic resinous coatings accelerate the degradation of the oil.
3. That the addition of moisture simulating an inadequately dried unit apparently affects the oil as much as it does the paper.
4. Neutralizers can be incorporated which apparently improve the system.

As a result of these tests, investigations were initiated to determine what characteristics would provide an improved oil and to develop more efficient inhibitors.

Recently a series of tests were completed on electrical grade kraft paper with and without amine inhibitors, cyanoethylated kraft paper and other inhibitors under consideration. All the systems retain about 20% of their initial strength after 100 hours at 225°C. However, if the test were short in duration one material may appear to be superior to another.

A curve of acidity versus time for the same three systems, shows both inhibited systems increase rather rapidly in acidity.

Prototype transformers were built and processed in the factory and placed on test in order to substantiate the ability of the most promising sys-

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tem and to determine the effect of oil characteristics while operating at a top oil temperature of 95°C. Tests show that oils which are apparently quite similar when tested in the laboratory do not necessarily perform the same in apparatus. Part of this difference is a result of the constantly changing oil temperature in apparatus as opposed to the unchanging temperature in oven samples, and part is a result of the effect of the manufacturing processes on the system.

In cooperation with other transformer manufacturers through the AIEE Working Group, tests on production units were initiated at 220°C and 180°C hot-spot temperature. The work of this group is still in progress and results have not yet been published. In addition to the program of the AIEE tests, a program of tests at 140°C was initiated. The results of these tests to date are of interest.

In summary, this series of tests indicates that:

1. Laboratory tests on small quantities of material, tested at elevated temperatures, are an efficient and quick method for screening new materials or systems. However, data from such tests should be used with extreme caution since these results cannot be reliably extrapolated to operating apparatus. Further, these tests must be made long enough in duration to ensure that conclusive results are obtained.
2. New standards for transformer oil performance were established for higher temperature operation. These standards were evolved through low temperature long time tests.
3. Tests on full size transformers indicate that systems incorporating the least number of materials and materials shown to produce a minimum of acidic by-products will have a life expectancy of at least 50 years at a hot-spot temperature of 105°C. Ratings of 65°C average copper rise are now possible and additional revision of the existing loading guides can be effected.

Silicones in Enclosed D-C Machines

By U. M. Elder, Westinghouse Electric Corp.

In the past six years hundreds of totally enclosed silicone insulated d-c

machines have been put into service operating at temperatures from class B up to 180°C without excessive brush wear.

It is generally agreed that silicones applied in open d-c machines—where the concentration of silicone contaminate is maintained at a low level by continual mixing with normal air—results in no ill effects. It is not generally known that brush wear is not seriously affected in totally enclosed d-c machines employing a properly engineered silicone insulation system and operating within the temperature limits of class B insulation. Nor is it common knowledge that successful applications have been made with enclosed silicone insulated d-c machines operating at temperatures of 150°C and higher. Originally, to solve the brush wear problem, the following approaches were used: 1) Develop silicone resins which would not affect brush wear. 2) Develop brushes which would overcome the silicone effect. 3) Develop a mechanical means of eliminating the cause. 4) Develop an insulation system which would fulfill the requirements of the manufacturer as well as the user.

In the process of investigation it was discovered that “aging” or degree of cure of the silicone resin had a decided effect on the wear rate of a brush. Studies also revealed that silicone rubbers such as used on wire and cable and silicone greases had a like effect on brush wear due to lack of ability to “cure-out” to the extent possible with silicone varnishes.

The same approach was taken with respect to carbon brushes as to the silicone resins; that is, overcome the brush-wear problem by development of a special brush or brushes. The concentrated effort expended in the development, investigation, and testing of carbon brushes revealed that the temperature of brushes had a real effect on brush wear even with no silicone present. Success in the primary purpose was achieved also in this phase of the program.

The third method of providing mechanical means, such as the use of chemical filters to remove the silicone contamination or providing cold spots for concentration and collection of

silicone contaminate, has not produced as dramatic results as the first two approaches to the problem. Since the progress in this field has been limited and the economic and commercial problems were questionable—particularly for standard industrial machines—less effort has been expended to develop a practical system.

Having achieved success in the primary purpose of developing silicone resins and processes which reduced brush wear to normal; and having developed brushes which would wear at a normal rate in the presence of silicone, there remained the problem of combining both advancements to produce a compatible system. It was essential that the resultant system be economical and practical both for the manufacturer and the consumer. For instance, it was impractical for the manufacturer to resort to unnecessarily long cures or extremely high temperatures. By careful analysis of the accumulated data, a silicone insulation system was created which combined a time-temperature cure of a selected silicone resin that reduced the silicone concentration to a level where selected commercial brushes showed no excessive wear. Extensive laboratory and manufacturing tests plus field experience have verified this insulation system.

Electrical Tracking Resistance Of Polymers

By G. M. L. Sommerman, Westinghouse Electric Corp.

This paper summarizes a four-year investigation of electrical surface-tracking properties of many types of synthetic polymers, including thermoplastic dielectric (for technical reference), rigid casting resins and laminates for enclosed outdoor apparatus, and rubbery encapsulating compounds for outdoor components, with and without various fillers, mostly inorganic. Tracking under moist conditions was obtained with a salt-dust and fog test, and dry tracking was measured with a low-current arc-resistance test (ASTM D495).

A number of unfilled polymers (thermoplastic, elastomeric and rigid-crosslinked) were investigated as a basis for studies of filled compounds. Comparison of data indicates many



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cases of correlation between the tracking resistances measured with the dust-fog test and the dry-arc test. In general, it is evident that both the wet and dry tests indicate that tracking resistance is high for most non-aromatic straight-chain organic compounds not containing both halogens and hydrogen, and low for most compounds containing phenyl groups (rings), or numerous branched chains (tertiary and quaternary carbon atoms), or both chlorine and hydrogen. Compounds with amine and amide groups are usually low in wet-tracking resistance although high in dry-arc resistance.

The addition of inorganic fillers usually improves the tracking resistance of materials in both types of tests, although the wet-tracking resistance is usually not increased much by ordinary fillers. Thus, epoxies and polyesters (all of which contain phenyl groups) when filled with ordinary nonhydrated-mineral fillers, readily track under moist conditions although they may resist dry-arc tracking fairly well. However, non-hydrated mineral-filled elastomeric

silicones (with little or no phenyl-group contents) are very wet-track resistant but very dry-track susceptible.

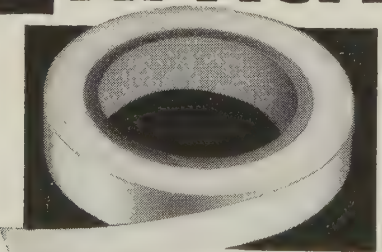
The addition of large amounts of hydrated fillers (e.g., $\text{Al}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$), greatly improves the tracking resistance (both wet and dry) of many polymers such as butyl rubber, epoxy resins and (some, but not all) polyester resins and elastomers. In fact, the formation of conducting surface tracks may be eliminated entirely in such polymers if sufficient hydrated filler is used. For these materials, short-time D495 tests may be employed to predict the optimum amounts of hydrated fillers required to eliminate tracking under moist conditions.

When hydrated fillers are added to very weak materials, such as phenolics, "dicy" resins and most highly chlorinated cyclic polyesters, however, the wet tracking resistance is not improved significantly (even with filler contents as high as 65%) although the dry-arc resistance is improved considerably.

The "standard" dust-fog test methods, although complex and time con-

suming, give sufficient repeatability of results to permit comparative evaluation of the track resistance of materials over a very wide quality range (0.4 to 3000 hours). This is apparently a much greater quality range than can be measured with the best drop-test methods standardized elsewhere. A revised form of the dust-fog test provides a much greater rate of degradation by enhancing tracking tendencies; also, the rate of degradation is less time-dependent compared with the "standard" tests. Both tests give results that may be correlated with the chemical structure and filler content of polymers; also both tests give results that correlate with the results of ASTM D495 arc-resistance tests for many unfilled and hydrated mineral-filled polymers. The D495 test may be employed to detect some wet-track susceptible materials and to predict the optimum contents of hydrated fillers used to improve the wet-track resistance of many types of polymers that do not contain too high a proportion of phenyl rings, chlorine together with hydrogen, or amine and amide groups in their structures.

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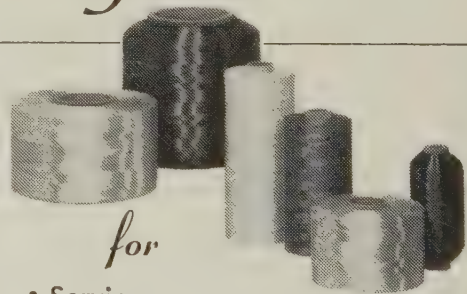
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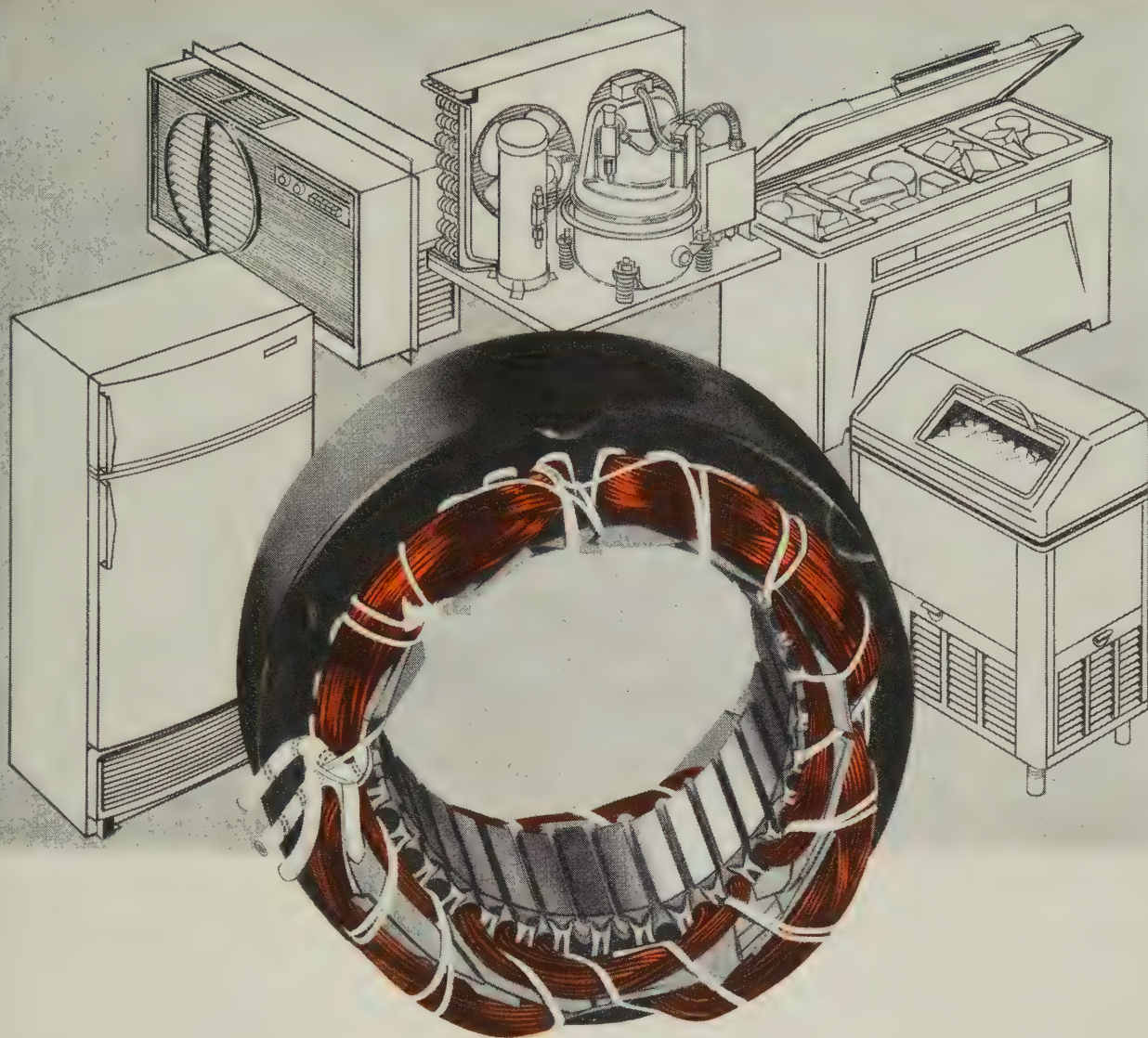
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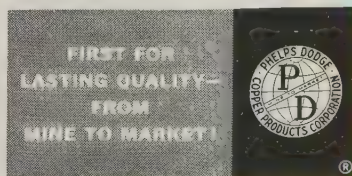
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Association News

Ferry Receives Award for Work in Colloid Chemistry

Professor John D. Ferry (left in photo) of the University of Wisconsin has received the seventh annual Kendall Company award of \$1,000 in recognition of outstanding contributions to the science of colloid chemistry. The presentation was made at the



general meeting of the American Chemical Society in Cleveland, Ohio, by Dr. John H. Hollister, Industrial Products Section, Chicago Research Lab., The Kendall Co. Dr. Ferry's most outstanding research accomplishments have been in the area of the mechanical properties of organic high polymers.

Kitzmiller Named Coordinator for Live Better Electrically Program

Frank Kitzmiller Jr. has been appointed to the new position of inter-industry coordinator for the Live Better Electrically Program of Edison Electric Institute. The Institute is the trade organization of investor-owned electric utilities.

ASA Schedules Conference On Automation Standardization

In order to coordinate the various viewpoints that have already begun to appear with regard to standards for automated systems, National Electrical Manufacturers Association and Electronic Industries Association have requested the American Standards Association to call a general conference on automation standardization. A tentative date has been set for Sept. 20, 1960, at ASA headquarters.

The purpose of the conference will be to discuss the problem and its

possible solution within the framework of the ASA. Relatively few standards exist which embrace the concepts of this new technology, and many technical groups are presently individually engaged in their formulation. The conference hopes to prevent the confusion that can result from the fostering of divergent industry standards.

International Machinery Show

Latest machine equipment will be displayed at the 2nd International Coliseum Machinery Show, Sept. 7-15 in the Chicago Coliseum.

Show hours will be 1 to 10 pm daily, except Sunday.

Sutro Named SPE PR Chairman

Frederick C. Sutro Jr., immediate past president of the Society of Plastics Engineers, has been appointed chairman of the society's public relations committee. Long active in SPE activities, Sutro will be responsible for establishing policy and planning society public relations activities on a long range basis.

IRE Meeting on Electronics In Nuclear Science

The latest developments in the field of electronics in nuclear science will be discussed at the Seventh Annual Meeting of the Professional Group on Nuclear Science of the Institute of Radio Engineers. It will be sponsored jointly by PGNS and Oak Ridge National Laboratory at Gatlinburg, Tenn., Oct. 3-5. The theme will be "Solid State Radiation Detectors and Low Noise Amplifiers." More than 20 technical papers on this subject are expected to be presented.

AWS Fall Meeting in Pittsburgh

The American Welding Society will hold its National Fall Meeting Sept. 26-29 at the Hotel Penn-Sheraton, Pittsburgh, Pa.

Seventeen technical sessions are scheduled with 51 papers to be presented. Each section will deal with a particular process or subject, includ-

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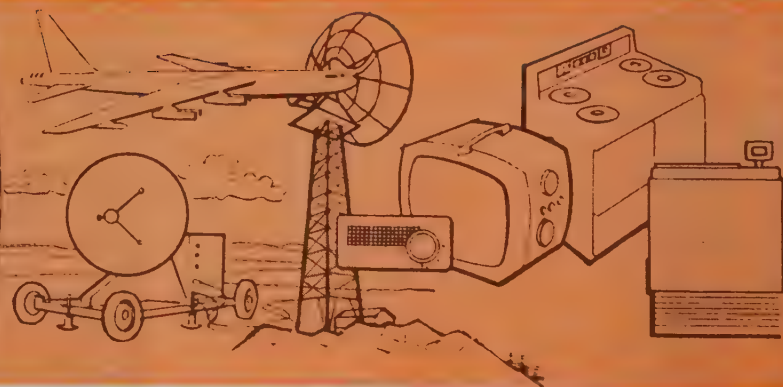
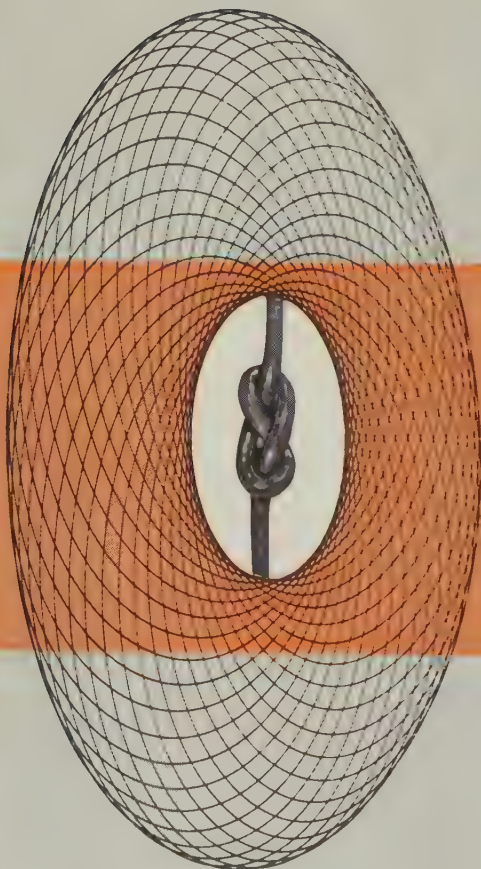
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**SPE Plans Retec on Plastics
In Business Machines**

The first SPE Regional Technical Conference devoted entirely to "Plastics in Business Machines" will be held Sept 22 at the Sheraton Inn, Binghamton, N.Y. Sponsored by SPE's Binghamton Section, the conference will include papers on the significance of liquid epoxy resins, epoxy resin molding compounds, polycarbonate applications, flame retardant laminates, and (tentative) encapsulation of electronic components.

The luncheon speaker, Dr. Matthew Braidich, Research Director of the National Board of Fire Underwriters, will describe the work of a newly organized committee of the Electronics Computer Systems Division of the National Fire Protection Association which is investigating fire safeguards in electronic computer systems.

**National Electronics Conference
Booth Space Is Sold Out**

Exhibit space in the 1960 National Electronics Conference to be held at the Hotel Sherman in Chicago on October 10-12, has been completely sold. The exhibit space was sold out shortly after being placed for sale in early April and there is a sizable waiting list of new exhibitors with applications still being received. These electronic firms will be guaranteed space at the 1961 Conference.

The NEC will move to the Interthere will be sufficient room to accommodate new exhibitors. In 1961 the Hotel Sherman will continue to be the official NEC hotel.

Approximately 100 papers will be presented in a variety of technical areas.

**New Officers, Other News of ASTM
Insulating Materials Committee**

New officers of the American Society for Testing Materials' Committee D-9 on Electrical Insulating

Materials are A. H. Scott, National Bureau of Standards, chairman; E. B. Snyder, Bentley-Harris Manufacturing Co., vice chairman; J. R. Taylor, Monsanto Chemical Co., membership secretary; and Thomas Hazen, Union Carbide Plastics Co., recording secretary. The new officers began serving their two-year terms at the close of the recent 1960 annual meeting in Atlantic City.

The committee will next meet during the fall meeting of the Society at the Sheraton-Cadillac Hotel, Detroit, on Oct. 5-7.

Action taken by the D-9 advisory committee includes approval of the following scope statement for new Subcommittee XIII on Composite Insulating Materials: "The formulation of specifications and the preparation of methods of test for nonrigid materials combined by adhering two or more essentially integral insulating materials, or an insulating material and metallic foil, to form a composite product." In addition, a new subcommittee on electrical (dielectric) films has been authorized.

**Form New ASTM Committee on
Ceramics for Electronics**

A new Committee C-25 on Ceramics for Electronics has been approved by the American Society for Testing Materials. The proposed tentative scope is: "Definition of terms and formulation of test methods and specifications covering ceramic materials for electronic applications, and promotion of research in this field . . . The principal materials included in this scope are: low-loss dielectrics, ferroelectric and ferromagnetic ceramics, and ceramic type semiconductors and composites. The scope does not include materials for electron tubes of all kinds, electric discharge and semiconductor devices, and low-frequency electrical tests."

1960 Power Meet At Philadelphia

The 1960 National Power Conference, sponsored by the power divisions of the American Institute of Electrical Engineers and the American Society of Mechanical Engineers, will be held at the Bellevue Stratford Hotel, Philadelphia, Sept. 21-23.

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TURBOLEX 85† Vinyl A.S.T.M. D-922, Grade A	-32° to +60°C
TURBOLEX 76† Vinyl MIL-I-631C, Grade a	-39° to +80°C
TURBOLEX 40† Vinyl MIL-I-22076	-55° to +80°C
TURBOZONE 40† Vinyl MIL-I-7444B	-67° to +75°C
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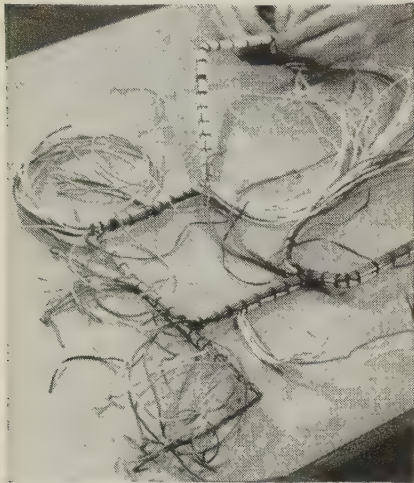
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New Publications

Books

1959 Annual Report of the Conference on Electrical Insulation. Contains summaries of 25 papers presented at the latest conference. Paperbound, illustrated, 153 pages, \$4. Order Publication 756 from the Printing and Publishing Office, National Academy of Sciences — National Research Council, Washington 25, D.C.

Professional Engineer's Examination Questions and Answers, by William S. LaLonde Jr. Second edition. 615 pages, 5½" x 8", 273 illustrations, \$7.50. McGraw-Hill Book Co., 330 W. 42nd St., New York 36.

Self-Saturating Magnetic Amplifiers, by Gordon E. Lynn, Thaddeus J. Pula, John F. Ringelman, and Frederick G. Timmel. 215 pages, 6" x 9", 151 illustrations, \$8. McGraw-Hill Book Co., 330 W. 42nd St., New York 36.

NAB Engineering Handbook. Revised fifth edition covers latest methods, facts, and data for radio and television engineering. 1664 pages, 6" x 9", 1306 illustrations, \$27.50. McGraw-Hill Book Co., 330 W. 42nd St., New York 36.

Source Book in Mathematics, edited by D. E. Smith. Unabridged reprint of papers in which 93 of the greatest mathematical discoveries were originally presented. Paperbound, 2 volumes, 725 pages, 6" x 9", \$3.50. Dover Publications Inc., 180 Varick St., New York 14.

Advances in Vacuum Science and Technology. Contains the 156 papers presented at the First International Congress on Vacuum Techniques held in Belgium. 2 volumes, 884 pages total, 11¼" x 8¾", \$30 per set. Pergamon Press Inc., 122 E. 55th St., New York 22.

Fixed and Variable Capacitors, by G. W. A. Dummer and Harold M. Nordenberg. New book provides a working knowledge of capacitor design and construction. Characteristics and applications of paper, mica, ceramic, glass, vitreous enamel, electrolytic, gas-filled, and other fixed ca-

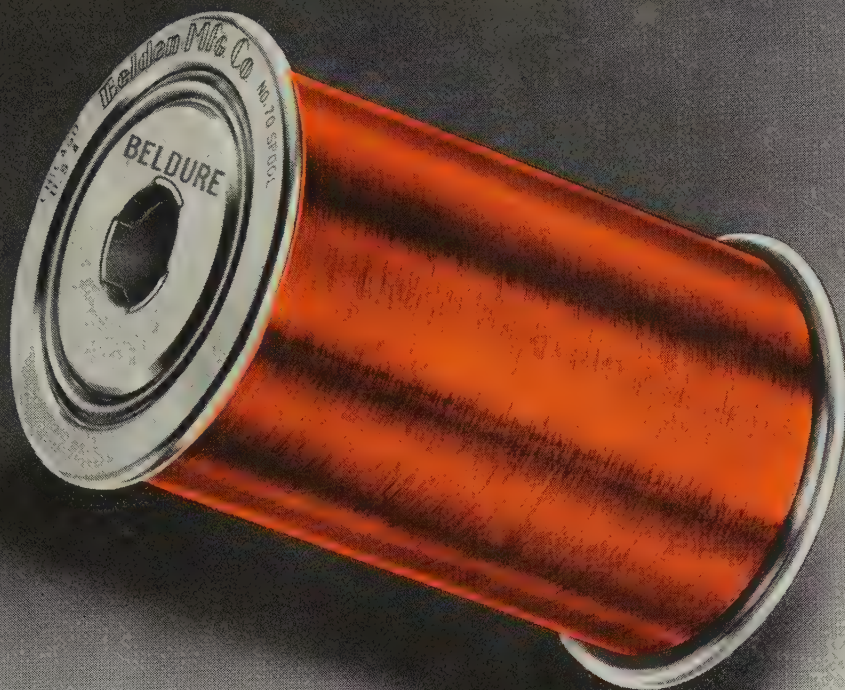
pacitors are covered with construction details described according to the dielectric materials used, and information on the full range of variable capacitor types is provided. Much general information on both types of capacitors is also included. Possible capacitor failures are described, future potentials and possibilities of capacitors, and new types of experimental capacitors are discussed. 281 pages, 6" x 9", 167 illustrations, \$10. McGraw-Hill Book Co., 330 W. 42nd St., New York 36.

Infrared Radiation, by Henry L. Hackforth. This new book thoroughly explains infrared radiation—what it is, what it does, and how it is used. It brings together information on components and the laws of physics by which they operate, sources of radiation, methods of transmission, and the analysis and design of systems. 288 pages, 6" x 9", 169 illustrations, \$10. Order from McGraw-Hill Book Co., 330 W. 42nd St., New York 36.

Avionics Research, edited by E. V. D. Glazier, E. Rechlin, and J. Voge. Contains papers on satellites and problems of long range detection and tracking presented at the Agard Avionics Panel Meeting in Copenhagen. 265 pages, 9¾" x 6⅛", \$10. Pergamon Press Inc., 122 East 55th St., New York 22.

The Relay Protection of High Voltage Networks, by G. I. Atabekov. This translation from the Russian is a theoretical monograph covering electrical protective gear. Professor Atabekov is an outstanding professional engineer who has been awarded a Stalin Prize for his work. Illustrated, 576 pages, \$14. Pergamon Press Inc., 122 East 55th St., New York 22.

New Polymers—New Problems, by Herman F. Mark. A copy of the Edgar Marburg Lecture presented at the 1959 annual meeting of the American Society for Testing Materials. It covers problems in the polymer field and their behavior properties. 12 pages, \$1. ASTM, 1916 Race St., Philadelphia 3.



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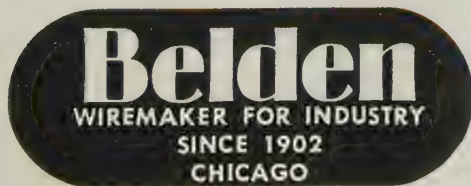
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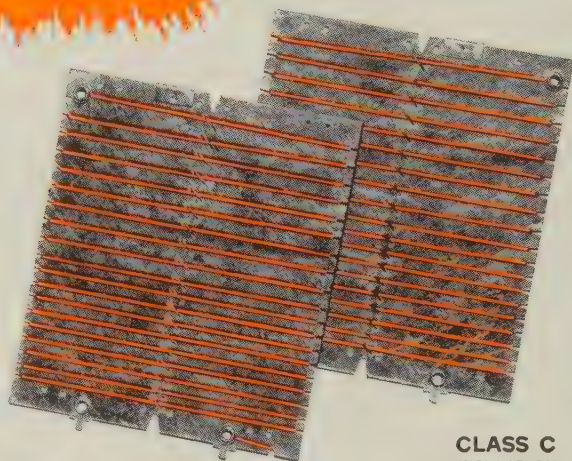
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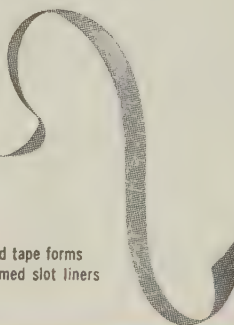
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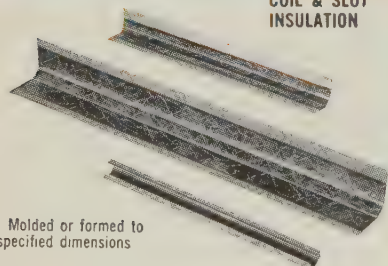
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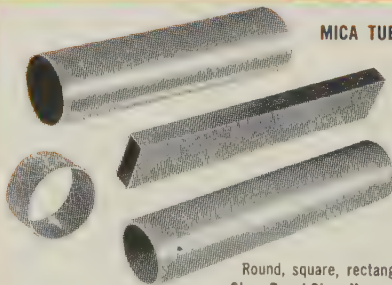


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ASTM Proceedings, Vol. 59 (1959).

Record of the technical accomplishments of the year includes reports, papers, and discussions. A subject and author index covers all papers published in any form by the Society in 1959. 1424 pages, \$12. American Society for Testing Materials, 1916 Race St., Philadelphia 3.

ASTM Standards

The following standards publications may be obtained from the American Society for Testing Materials, 1916 Race St., Philadelphia 3.

ASTM Compilation of Standards on Rubber Products, D-11. This 19th edition is over 10% larger than the last edition published in May, 1958. Its 163 standards include 22 that are completely new and 66 that have been revised or changed in status. Among the new standards are several covering cellular materials of poly (vinyl) chloride or copolymers and urethane foam, two on the effects of radiation, and several on carbon black. Topics include electrical tests, tape, wire and cable, etc. Hard cover, 1052 pages, 6" x 9", \$9.75.

ASTM Index to Standards. Annual index refers to publications where standards or tentatives appear in their latest form. 232 pages. Single copy furnished free, additional copies \$1.

International Symposium on Plastics Testing and Standardization—STP 247. Hard cover, 276 pages, \$6.

Compilation of ASTM Standards on Metallic Electrical Conductors B-1. Latest edition contains 59 standards of which three are completely new and 36 are revised or have had their status recently changed. Hard cover, 368 pages, 6" x 9", \$4.50.

Government Publications

Army 1960 Research Task Summary. Several volumes contain, in highly condensed form, all scientific research monitored by the Army. Prices and order numbers are: Volume 2, Chemistry, \$3.75, PB 161134; Volume 3, Physics, Part I, \$3.75, PB 161135; Volume 4, Physics, Part 2, and Geophysical Sciences, \$3.75, PB 161136; Volume 5, Engineering, \$4.25, PB 161137; Volume 6, Mate-

rials, Technologies, Mathematics and Operations Research, \$4.50, PB 161138; and Volume 7, General Index, \$3, PB 161139. Order from the Office of Technical Services, Dept. of Commerce, Washington 25, D.C.

The following publications should be ordered by number from the Supt. of Documents, Govt. Printing Office, Washington 25, D.C.

MIL-STD-439A (WEP), Electronic Circuits. Establishes performance criteria for standard circuits. 262 pages, \$1.50. Catalog No. D 7.10:439A-(WEP).

Armed Services Procurement Regulation. Revision No. 52, March 15, 1960, contains revised pages for sections 1, 2, 3, 7, 8, 9, 10, 12, and 16, and appendixes B and C. 126 pages, 60 cents. Catalog No. D 1.13/2.52.

General Procurement Information on Guided Missile Programs, Rockets, and Target Drones. Includes listings of the Department of the Army, Navy, and Air Force missile and rocket systems and prime contractors in missile work. Revised in 1960. 30 pages, 15 cents. Catalog No. D 7.2:M 69/960.

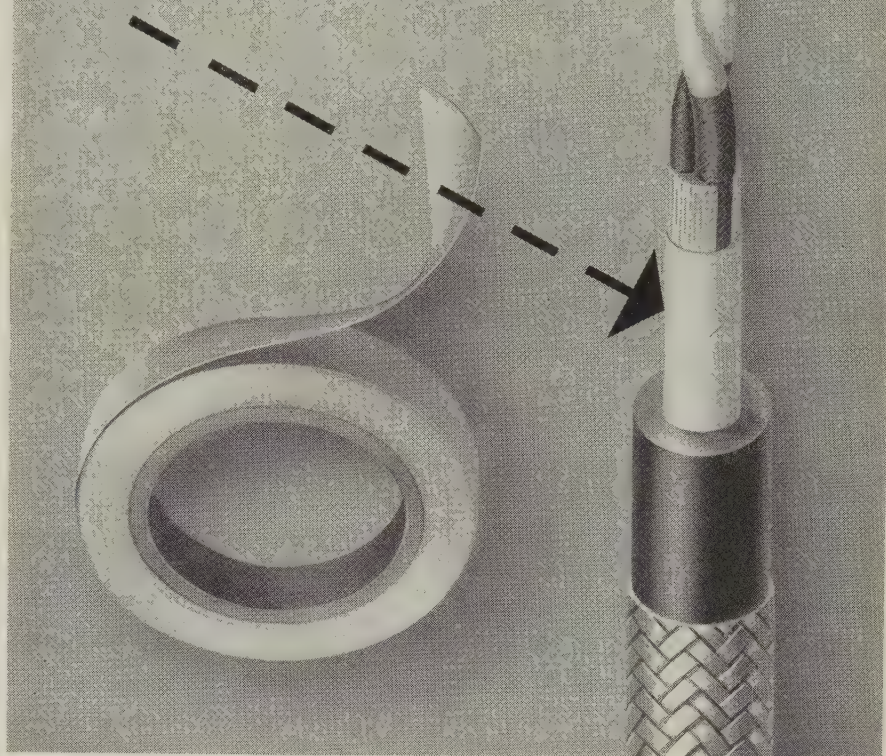
Electron Tubes, Interchangeability Directory. Provides a list of electron tube types used in Armed Service equipment or stocked in depots, together with a cross reference to any other type numbers or designations these tubes may have. 1959, 230 pages, \$1.50. Catalog No. D 7.6/2:213.

Polyethylene Film. A recorded voluntary standard covering dimensional tolerances, types, grades, classes, and kinds of polyethylene film, intrinsic quality requirements, and test methods. 30 pages, 15 cents. Catalog No. C 41.25:227-59.

Armed Services Procurement Regulations. Revised 1960 edition includes all the material in the 1955 edition and its 54 revisions issued through May 1960. Sold on a subscription basis, consisting of the basic manual and supplementary service for approximately 2 years. \$18 (\$4.50 additional for foreign mailing).

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minimum burst pressure, and marking for two types of rigid unplasticized polyvinyl chloride pipe. Rev. 1960. 9 pages. Catalog No. C 41.25:207-60. 10 cents.

Electron Tubes, Techniques for Application of in Military Equipment. Rev. 1958. 684 pages. Catalog No. D 7.6/2:211. \$3.25.

Appendix A to Electron Tubes Techniques for Application of in Military Equipment. It goes beyond the handbook in dealing with various application problems which are commonly encountered in complex equipments. It discusses the design of circuits and provides specification and application data for 20 receiving tubes which were not covered in the handbook. 222 pages. Catalog No. D 7.6/2:211/app.A. \$1.25.

Electron Tubes; and Semiconductor Devices, Diode: MIL-STD-200E. Provides a list of electron tubes used by the Departments of the Army, Navy, and Air Force; requirements for application and utilization; and requirements for reporting of electron tube complements. 14 pages. Catalog No. D 7.10:200E. 25 cents

Other Literature

Tubes and Transistors: A Comparative Study. Discusses the advantages and limitations of both components. 64 pages, free. Electron Tube Information Council. 554 Fifth Ave., New York 36.

Welding Handbook Section III. The third section of the fourth edition of the welding handbook has been expanded to include adhesive bonding, welding of plastics, and ultrasonic welding. Clothbound, 512 pages, 335 illustrations, 78 tables, \$9. American Welding Society, 33 W. 39th St., New York 18.

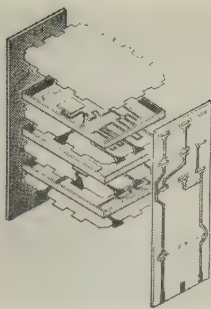
National Electrical Code Amendment No. 113. A tentative interim amendment to the 1959 edition of the National Electrical Code, No. 113, concerns recognition of two classifications of fuses, 601-800 and 801-1200, instead of the one classification of 601-1200. National Electrical Code Committee, National Fire Protection Assn., 60 Batterymarch St., Boston 10, Mass.

Microminiature Circuits

A technique for packaging micro-miniature electronic circuits on a series of stacked wafers, each smaller than a postage stamp, has been developed by Sylvania Electric Products Inc., a subsidiary of General Telephone & Electronics Corp.

The small size and ultra-reliability of the versatile circuit package—called the Sylvania Microminiature Module—are said to suit it for initial application in command guidance, communications, digital control, and other electronic circuits within missiles and satellites. Ultimate commercial use will lead to microminiaturized computers, display equipment, radio transceivers, and telephone exchange equipment. Fabrication of pilot quantities is expected to be under way by the end of the year.

The module's wafer element, the heart of the over-all circuit package, maintains a complete functioning circuit stage on a surface less than one-half inch square and 1/100th of an



inch thick. The entire stage is hermetically sealed at one time by a tiny fused spacer element which provides protection from the atmosphere and from neighboring circuits.

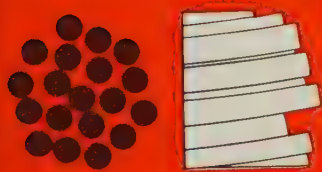
By interconnecting stacked wafers through vertical, silk-screened interwiring boards, the number of circuits required are obtained in substantially lessened space. For example, the function of a conventional printed circuit board 6 inches long and 1½ inches wide reportedly can be carried out by a six-wafer Sylvania module ⅜ths of an inch high and less than a half inch square.

The Sylvania module is expected to accommodate both present micro-

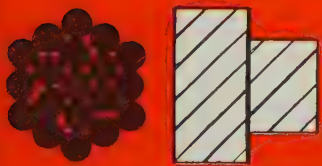
components and future solid-state and molecular circuits, and mixtures of both, on an economical, reliable, and maintainable basis.

Advantages claimed are: 1) The wafer contains sufficient active area for a functioning stage of circuitry. 2) Each circuit stage is hermetically sealed. 3) There is stage-to-stage interconnection without wires, and total assembly plug-in is provided through a module interconnecting board. 4) Construction and seal materials are capable of operations at extremely high temperatures. 5) Construction and assembly methods provide the capability for economical, automated mass production. 6) Construction technique provides immediate capacity for packaging 600,000 electronic parts within one cubic foot of space, and future potential for packaging more than 30-million parts within the same area. 7) Construction technique is "obsolescence-proof," since it satisfies film and solid-state developments, expected over the next five years, that will permit multiple stages on one surface area.

Which Wire Construction is Best . . .



BUNCH



UNILAY



CONCENTRIC

Hudson makes all three in bare and plated constructions. Each is best suited for particular applications and insulating materials. For many years, the industry "standards" were bunch and concentric strandings. But with Hudson's marketing of unilay, there has been a strong swing to this versatile construction.

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BUNCH constructions are generally used for flexible cords and fixture wires complying with UL standards, ASTM, and all military specs where permitted.

UNILAY constructions should be utilized where concentricity is a major requirement, or for economic reasons to get more for your insulating dollar. Since unilay constructions are preformed and twisted in the same direction, they are uniform and smaller in O.D. than bunched or concentric constructions. Unilay constructions are suited for all bunched applications, and are being substituted for concentrics in many applications with comparable performance at considerably lower conductor cost.

CONCENTRIC Where concentric strand conductors are required by customer or military spec, Hudson's concentric wires will meet the most exacting requirements.

For additional information on stranded and single-end conductors — bare and plated — write to:

HUDSON WIRE COMPANY
OSSINING DIVISION, OSSINING, NEW YORK / TELEPHONE: WILSON 1-8500

Epoxy Cast Conductivity Cells

By Dr. Robert Rosenthal, Chief Chemist, Industrial Instruments Inc., Cedar Grove, N.J.

Where service requirements are stringent, epoxy cast conductivity cells are desirable because of several advantages: a) the epoxy resins have excellent chemical, mechanical, and electrical properties; b) they are resistant to impact, abrasion, high temperatures, and most acids and alkalis; c) they permit a more uniform industrial design of cells to meet a wider range of service conditions; and, d) they have exceptional adhesion to metals.

Presently the epoxy cast cells are constructed for use as dip cells, screw-in cells, and valve type insertion cells. Chief areas of usefulness for these cells lie in: 1) The measurement of pure water where the low solubility of the cured resin in water prevents contamination of the very material whose purity it is designed to maintain. 2) In checking the total dissolved solids content of boiler water

samples, considered particularly rough service because of the sludge and abrasive solids which quite often are present in boiler blow-down lines. Operating temperature in these applications is usually around the normal atmospheric boiling point of water since samples are cooled and pressure-reduced before they contact the conductivity cell. 3) In strong caustic solutions such as lye peeling where the sodium hydroxide content may rise to 15 or 20 percent and the temperature close to 200°F. 4) And in caustic bottle washing solutions in the soft drink and beer industry, and in maintaining and controlling detergent strength in industrial washing equipment.

Selecting the epoxy resins for casting purposes came about only after it proved economically impossible to produce an injection molded cell which would satisfy all service condi-

tions. For this reason we decided on cast-type cells to permit short runs of various types at relatively reasonable unit costs. In past years several types of resins were tested, including the furanes and polyesters, but they proved inferior to the epoxies. The furane resins exhibited poor resistance to rapid temperature changes. With the polyesters, it was not possible to strike a good balance between shock characteristics and chemical resistance.

Production Techniques

Despite the large variety of cast epoxy cells manufactured, production methods are quite uniform. In almost all cases the electrodes (either platinum, nickel, or graphite) are mounted snugly on a round steel mandrel. The mandrel is mounted in a mold and all components other than the electrodes

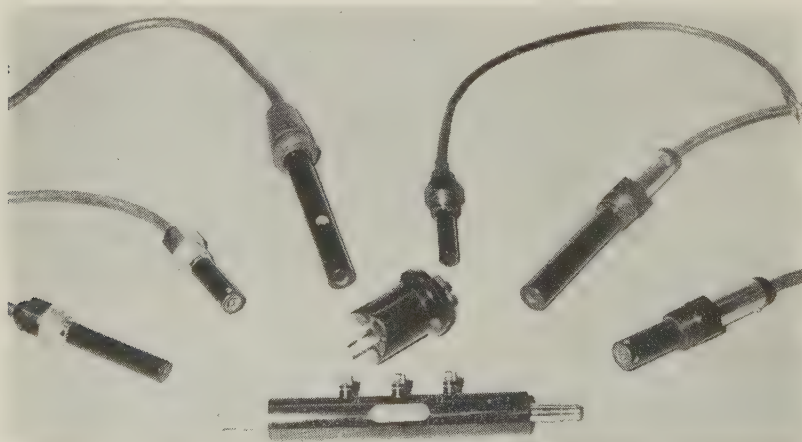


Figure 1, epoxy cast conductivity cells in various sizes and configurations for measurement and control of solution concentration.



Figure 2, mixing of resin and curing agent.

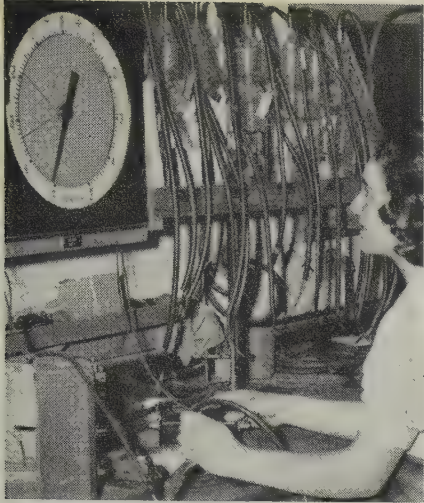


Figure 3, each conductivity cell undergoes testing for electrical continuity, insulation leakage, and adjustment of cell constant.

and lead wires are treated with a mold release. Resin and curing agent¹ are weighed carefully in the desired batch quantities and a black pigment is mixed in. The mixture is transferred to a pressure bottle similar to the equipment used in pressurized paint spraying. Resin is forced out by means of air pressure through a relatively narrow tube into the mold.

Processing consists of allowing the resins to gel overnight, followed by "B" staging, and finally by curing in an oven. When cure has been completed, the mold is opened, the mandrel pulled out and the cell assembled to cable. In some cases the cell is attached to threaded epoxy fittings so that the finished cell can be screwed into a pipe line or through pipe fittings into a tank wall.

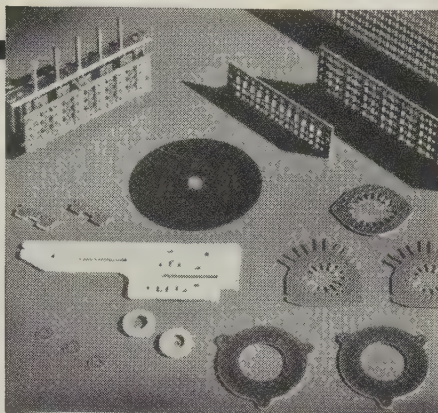
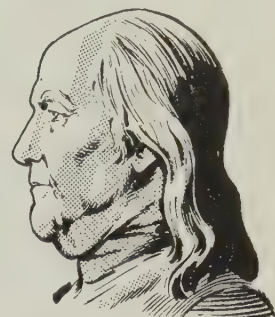
The glass smooth finish of the conductivity cells simplifies cleaning and servicing, and also reduces the tendency of the cell to accumulate solids which could possibly change its characteristics.

Each cell is thoroughly tested—under pressure to ensure tightness of connections and for electrical continuity, insulation leakage, and adjustment of the cell constant.

1. "Epon" 828 and curing agent Z (Shell Chemical Co.)

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- Superior Electrical Properties
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Richardson laminated, machined and fabricated parts are produced in a wide range of characteristics to meet many kinds of electrical and electronic applications. New grades, sizes, and shapes are constantly being developed for new applications.

Whatever your specific product application... electrical or mechanical... specify and insist on INSUROK. Write for comprehensive details in bulletin form on how you can profit by using INSUROK, or phone today.

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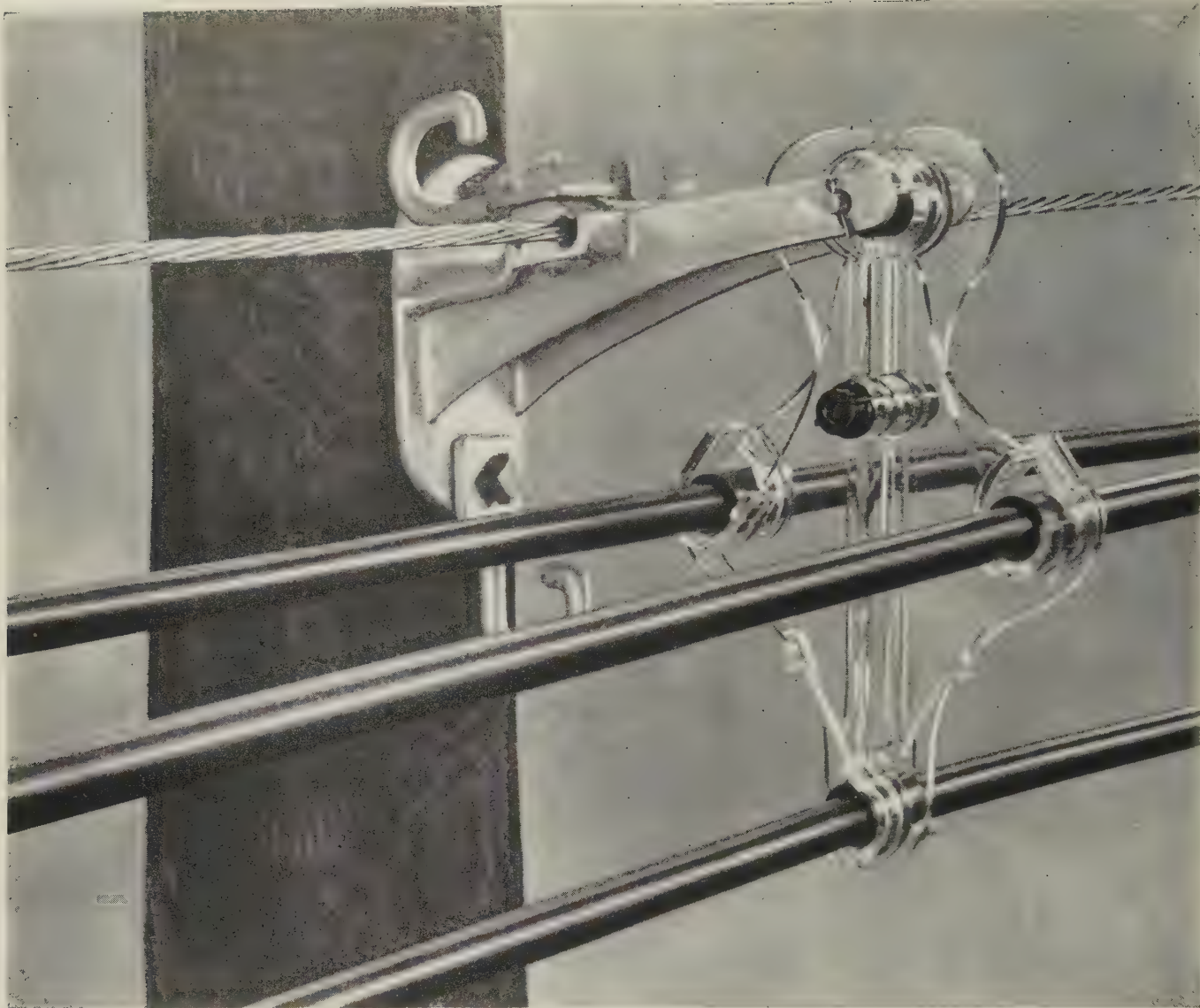
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AERIAL SPACER CABLE INSULATED WITH HIGH-DENSITY POLYETHYLENE



Aerial spacer cable, line wire, and triplex service drop made by Hendrix Wire and Cable Corp. and insulated with BAKELITE Brand high-density polyethylene DGD-4100.

One of the most impressive developments in the past two years has been the quick acceptance of aerial spacer cable insulated with BAKELITE Brand high-density polyethylene DGD-4100. The properties of this new polyethylene are so compelling that one manufacturer, Hendrix Wire & Cable Corp., Milford, N.H., reports that 34 utility customers* in 15 northeastern states have adopted aerial cable, line wire or triplex service drop insulated with DGD-4100.

The abrasion resistance of this high-density polyethylene sharply reduces the chance of injury to insulated phase conductors when stringing over crossarms. It also results in less damage by tree limbs—can even bring some reduction in tree trimming costs.

Along with these benefits, high-density polyethylene provides excellent shear strength, resists environmental and thermal stress cracking, and withstands deformation at high temperatures. These improvements are in addition to the familiar polyethylene advantages such as superior insulating properties, light weight, and ease of handling.

Try wire and cable insulated or jacketed with BAKELITE Brand high-density polyethylene DGD-4100 in your power distribution system and enjoy these multiple benefits. For more information and samples of this material, write Dept. BW-75, Union Carbide Plastics Company, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N.Y. In Canada, Union Carbide Canada Limited, Toronto 12.

*Names available upon request.

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A New Technique for Reducing Cost in Plastic Laminate Parts

By R. A. Anjesky, Mgr. Application Engr., The Glastic Corporation, Cleveland. Photos courtesy The Glastic Corp.

A new technique for producing laminate parts at lower cost and with greater precision is now being successfully applied to electrical insulating parts. The technique, called "Mold-fab," was first developed to produce "fabricated" switchgear panels with a "molding" method. Through the use of relatively inexpensive pinch-trim matched metal molds, fiber glass mat reinforced polyester parts are produced in the desired configuration without the material waste or fabrication labor associated with parts cut from stock-size sheets.

The technique is most applicable in glass mat reinforced polyester construction because: 1) curing of polyester resin gives off no gaseous by-product so that the part may be molded to exact size in closed pinch-trim molds; 2) glass mat may be trimmed by the pinch-trim molds, thus assuring reinforcement to the edge of the part; and 3) in the case of a non-flat part, glass mat may be "drawn," unlike cloth or paper reinforcement.

The first significant application of the "Mold-fab" concept was a molded barrier panel for switchgear. Originally, this 42" x 46" barrier was fabricated from a 48" square panel of $\frac{1}{4}$ " thick flame retardant paper-phenolic. In the conversion to a flame retardant glass polyester "Mold-fab" part, tooling was designed to produce the barrier exactly to print, complete with cut-outs (item 1, figure 1). Approximately 20% material savings were gained because no material was cut-off and thrown away as was the case when fabricating from stock sized 48" square sheets. The elimination of the fabrication labor also added to the savings. On this part, further savings were gained because

the higher physicals of glass-polyester allowed a thickness reduction to $\frac{3}{16}$ ". When the number of barriers used per month was multiplied by the total material and labor savings per piece, it was found that the mold cost would be fully amortized in about four months with a substantial reduction in part price possible after that.

An important secondary benefit

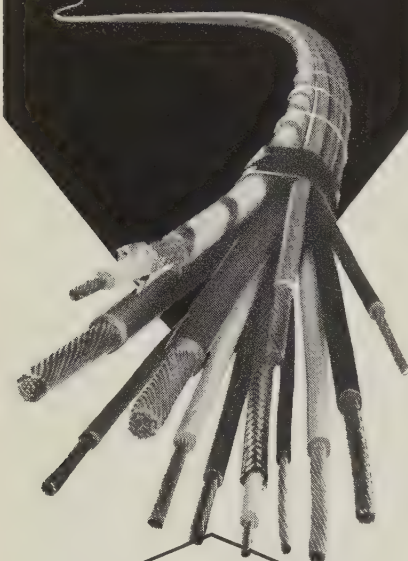
later developed after the manufacturer had gained experience in assembling the barriers into the apparatus. Dimensionally, each "Mold-fab" part is exactly the same, so the problems of rework or scrap caused by machining variations or human error no longer existed.

A variation of the technique resulted in the elimination of separate angles used in the assembly of a



Figure 1, some of the shapes possible with the "Mold-fab" technique. Item 1, a switchgear barrier. Item 2, a "three-sided-tray" box barrier for switchgear. Item 3, a switchgear arc-chute side plate .171" thick except for $\frac{1}{4}$ " thickness around hole.

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When you specify Teflon® FLEXLEAD for lead wire and cable applications, you're buying from the Line of Excellence . . . assurance of reliable performance. FLEXLEAD's tough coating of precision-extruded Teflon resists abrasion, moisture, corrosion; and withstands temperatures to 250°C without affecting its flexibility or superior electricals.

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switchgear box barrier. This barrier panel (item 2, figure 1) was produced with flanges as an integral part of the molding. These flanges, replacing separate angles that were previously fastened to the barrier, are used for mounting the end, top, and bottom pieces of the assembly. Because the thickness of this barrier was reduced from $\frac{3}{8}$ " in paper-phenolic to $\frac{1}{8}$ " in glass-polyester, two stiffening ribs were designed into the part to contribute rigidity.

Two more variations of the technique, molded-in holes and multiple thicknesses on the same panel, were used in a 5kv switchgear arc-chute side plate (item 3, figure 1).

The first design specified $\frac{1}{4}$ " glass mat polyester because of the impact forces generated by the operation of the arc-chute blow-out coil. This design placed a hole in the middle of the panel to accommodate the blow-out coil as well as a cut-out in one corner. Engineers designed a mold to produce the part to finished shape, complete with hole and cut-out. Then, further savings were offered by reducing the thickness to .171" except in the blow-out coil area where the

$\frac{1}{4}$ " thickness was retained for impact strength.

There are several other benefits available to designers through use of the "Mold-fab" technique. A wide range of colors is possible. Preprinted overlay sheets may be molded into the surface of the panel replacing engraving, silk-screening, or attached plates such as found on a control panel. After the mold is in production, the part may be molded thicker or thinner to the exact decimal dimension required to do the job at minimum cost. Because parts are produced with smooth, molded edges (unlike the machined or sheared edges of a fabricated part), appearance is improved while dirt and moisture pickup are reduced.

In considering application of the technique to a part, there must be sufficient usage of parts against which the material and labor savings are applied to justify the mold cost. Tooling costs for a flat panel are in the range of \$2 to \$4 per square inch of part area. Molds for parts with draws, multiple thicknesses, or molded-in holes are more expensive, but may offer even more significant savings.

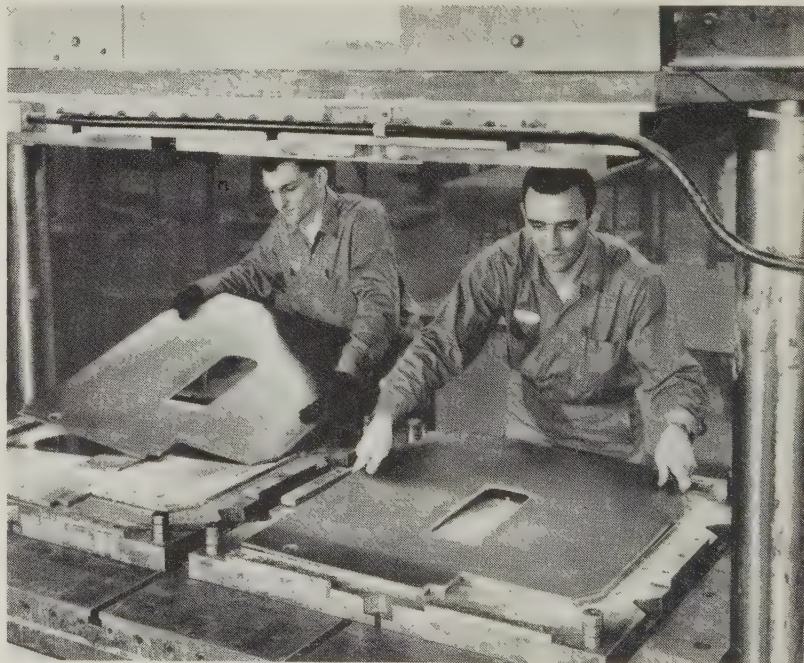
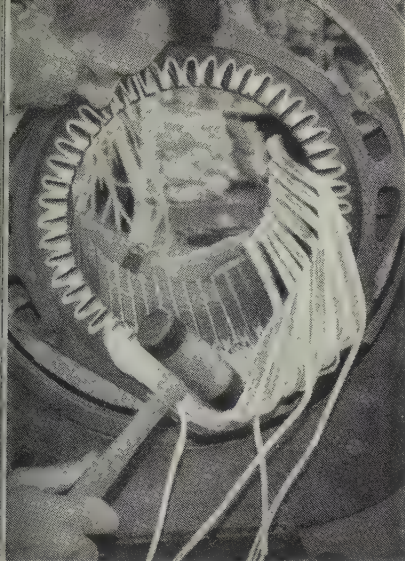


Figure 2, carbon-track resistant 15kv arc-chute side plates being removed from "Mold-fab" tooling. Two-cavity pinch-trim mold produces one left-hand and one right-hand part in each molding cycle. Note shape of mold that produces parts complete with large and small hole, exactly "to print."

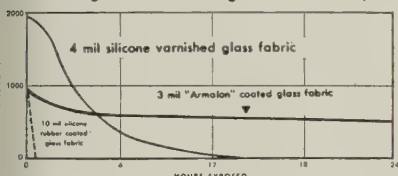


Characteristics of 2 outstanding Du Pont insulations

These Du Pont insulating materials represent a remarkable range and balance of electrical, thermal, chemical and mechanical properties

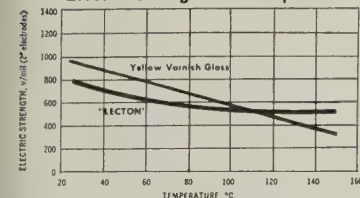
Insulation of "Armalon"*** TFE-fluorocarbon-coated glass fabric may be used continuously at 482°F. or for short periods at somewhat higher temperatures. It maintains its superior properties throughout long exposure to high temperature as shown in the chart below. For full information on this outstanding class H insulation, check the coupon.

Electric Strength vs. Time Aged at 375°C. (707°F.)



"Lecton"*** acrylic-resin-coated glass fabric is superior insulation of moderate price for hermetic and Class B applications. It can be used continuously at 270°F. and intermittently to 300°F. Chart below shows how "Lecton" maintains its electrical strength as the temperature rises. For full information on this outstanding class B insulation, check the coupon.

Electric Strength vs. Temperature



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- Unusual heat resistance
- Mechanical strength and extreme toughness
- Low flow under heat and pressure
- Excellent electrical characteristics over a wide range of temperatures and frequencies
- High degree of chemical inertness
- Excellent anti-adhesive, non-stick properties
- Low water absorption
- Outstanding flame resistance

SPECIFIC PROPERTIES* of single ply

	3 mils	6 mils
Dielectric strength (1/4" electrode)	> 750	> 500
Surface arc resistance, sec.	> 180	> 180
Dielectric constant 60 cycles 1,000,000 cycles	1.8 1.7	2.3 1.8
Volume resistivity, ohm-cm room conditions 300°C	10 ¹⁹ 10 ¹³	10 ¹⁹ 10 ¹³
Insulation resistance, ohms (96 hrs. @ 90% R.H., 25°C)	10 ⁸	10 ⁸
Breaking strength, lbs./in. of width, warp	> 40	> 50

Note: Standard single-ply constructions — available in 4, 5, 8, 10 mils, also — come in rolls or sheets 1/4" to 38" wide; laminates in rolls or 13" x 17" sheets — 6 to 25 mils thick.

LECTON®

GENERAL PROPERTIES

- Good heat resistance
- Mechanical strength and extreme toughness
- Dimensional stability
- Good retention of electrical characteristics to 310°F and under high humidity conditions
- Highly resistant to most solvents, transformer oils, fluorinated hydrocarbon refrigerants
- Good resistance to nuclear radiation
- Modest price

SPECIFIC PROPERTIES* of single ply

	3 mils	7 mils	14 mils
Dielectric strength (1/4" electrode) @ 25°C @ 130°C @ 25°C after 4 days at 90% R.H.	> 1000 > 700 > 900	> 800 > 600 > 700	> 600 > 500 > 550
Surface arc resistance, sec.	> 180	> 180	> 180
Volume resistivity, ohm-cm @ 25°C @ 130°C @ 25°C after 4 days at 90% R.H.	10 ¹⁴ 10 ¹² 10 ¹⁴	10 ¹⁴ 10 ¹² 10 ¹⁴	10 ¹⁴ 10 ¹² 10 ¹⁴
Breaking strength, lbs./in., average, W X F straight bias-cut	90x150	140x120 55	250x250
Elongation at rupture, % straight bias-cut	3 3	35	3

Note: Standard single-ply constructions — available in 5, 10 mils, also — come in rolls or sheets 1/4" to 60" wide; 7 and 10 mils offered both straight and bias-cut. Laminates supplied in rolls 20 and 30 mils thick, and in 18" x 18" sheets .060", .072", or 3/32" thick.

*Derived from standard testing methods. These data are a guide to properties and are not to be regarded as specifications.

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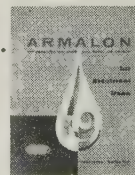
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New Products

For further information on these products print the item number on the Reader Service Inquiry Card on the back cover. Fill out and mail the card—no postage is required. Insulation will immediately forward your inquiry to the manufacturers concerned so that they can send you more information promptly.

New Filled "Teflon" 100-FEP Resin For Economical Molded Parts

A new molding powder of Teflon 100-FEP resin compounded with inorganic reinforcing materials, such as fiber glass, has been primarily developed for injection molding. It is said to allow many new applications for Teflon where cost has been a factor in the past. This filled material reportedly is stiffer, has a smaller shrinkage factor (up to 50%) in molding operations, and has better



wear resistance than the unfilled Teflon 100. Typical applications include coil forms and bobbins, tube sockets and connector assemblies for electronic purposes, and encapsulation. Crane Packing Co., Dept. IN-2, 6400 Oakton St., Morton Grove, Ill.

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Glass-Epoxy Laminate Maintains Strength at High Temperatures

A glass base epoxy laminate, Spauldite G11-820, is stated to maintain over 50% of its flexural strength at 150°C without any loss of its high electrical and mechanical properties. The material was created for extreme physical and electrical applications, such as in computers, missiles, and aircraft components. G11-820 is available in 40" x 48" sheets, copper-clad or unclad strips, blocks, or in parts fabricated to customer specifications. Thicknesses range from 1/32" to 1/2".

The material is flame retardant and self-extinguishing by ASTM-D635 and meets UL requirements. Spaulding Fibre Co. Inc., 310 Wheeler St., Tonawanda, N. Y.

Print No. Ins. 102 on Reader Service Card

Solventless Silicone Resin for High Temperature Electrical Uses

A solventless silicone resin for high temperature insulation, XR-65 silicone, is expected to have possible applications in almost every segment of the electrical/electronic industry. It can be used for form-wound coil impregnation, for lamination using wet lay-up techniques, and for potting and encapsulation. A 100% reactive silicone resin, it reportedly can be combined with organic monomers to provide tailor-made insulating resins. 6 page product data sheet available. Silicones Div., Union Carbide Corp., 270 Park Ave., New York 17.

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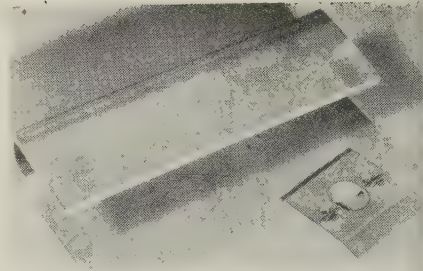
Epoxy Adhesive with High Tensile Shear Strength

A tensile shear of 2,200 psi at 300°F on aluminum-to-aluminum is claimed for Hysol 4322 epoxy adhesive. The smooth, thixotropic, 100% solids paste reportedly will not flow during cure . . . even when applied to vertical surfaces . . . and is said to be ideally suited for bonding porous surfaces. It is also recommended for bonding metal, plastics, ceramics, glass, and wood. A slight resiliency insuring against cracking during thermal shock and a 14-month shelf life at room temperature are other advantages cited. Bulletin A-304 available. Adhesives and Sealants Dept., Hysol Corp., Olean, N. Y.

Print No. Ins. 104 on Reader Service Card

Insulation Combines Benefits of Vulcanized Fibre, Phenolic Laminates

A new, relatively low cost insulating material is stated to combine the good electrical properties and mechanical strength of vulcanized fibre with the low moisture absorption of phenolic laminates. Known as "Anilite," the fibre material incorporates synthetic resins which reportedly give



it two to four times the moisture resistance of conventional vulcanized fibre. Some expected applications are circuit breaker and transformer barriers, knife switch guides, wiring devices, electrical fixture insulation, instruments and control panels, and magnetic coil heads. It is said to be an ideal insulation for appliances, household wiring devices and switches. Underwriters Laboratories have approved it for sole support of current carrying parts up to 150°C. Other features cited include good dimensional stability, retention of insulating properties in a variety of atmospheric conditions, flame resistance, superior arc resistance, and the ability to be drawn or formed into permanent shapes or punched and machined at low cost. National Vulcanized Fibre Co., 1060 Beech St., Wilmington 99, Del.

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Fast-Curing Phenolic Molding Powders for Electrical Applications

Over-all curing rates averaging 25% faster than those of conventional fast-cure powders are said to be exhibited by a new line of phenolic molding compounds designed for both cold-powder automatic molding and preheat compression and transfer applications. Electrical blocks and contact covers, lamp sockets, appliance handles, switch covers, socket bases, fan motor housings, and electrical receptacles are among typical parts that have been sampled and produced in quantity with curing rate reductions ranging from 15% to 35% over previously used materials. The powders, manufactured in standard industry flows and to a 14-mesh grind, are available in a preheat black as G-E 12956. A cold powder black and

NOW ... a simple, effective, low cost method of preventing electrical failure due to moist and corrosive atmospheres

Failure of physical or electrical characteristics of electrical and electronic equipment is often due to moisture and corrosion. Without effective moisture protection, deterioration sets in, leading to costly downtime, expensive repairs and high replacement incidence.

Dual-action CRC 2-26 eliminates or greatly reduces these failures. It displaces moisture on surfaces—gets into grain boundaries, cracks and pores—and leaves a thin, continuous molecular film that both stops and prevents corrosive action on metals, plastics, rubber, plated and painted surfaces.

Dimensional characteristics, contact resistance and other electrical constants remain unchanged. CRC 2-26 does not become dry, brittle or hard. Because it is non-irritating, non-toxic and has a high flash point, CRC 2-26 is easily applied without special precautions. It is used to maintain equipment year after year that formerly burned out or needed extensive servicing every few months.

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Reaction Consultants, 116-N Chestnut St.,
Philadelphia 6, Pa., or telephone WALnut 5-0200.
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aerosol
cans,
1 and 5
gal. cans,
55 gal.
drums



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a two-way brown are also available. Phenolic Products Section, Chemical Materials Dept., General Electric Co., One Plastics Ave., Pittsfield, Mass.

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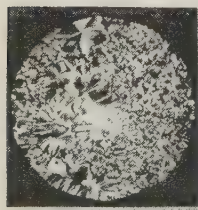
New Epoxy Resin Systems for Casting, Sealing, Potting, and Encapsulating

Two new epoxy resin systems are designed for a wide range of casting, sealing, potting, and encapsulating applications. *Meta-Cast 405 AP* is an all-purpose, filled epoxy casting system suitable for use from -60 to $+200^{\circ}\text{C}$. It is said to be particularly desirable for encapsulation of heat sensitive components because final cure is effected substantially free of exotherm. Excellent adhesion, uniformity of filler suspension, good machinability, and the absence of shrink-inducing reactive diluents are characteristics reported. *Meta-Cast 441* is a two-part, 100% solids epoxy casting compound which is especially recommended for sealing, potting, and/or encapsulating coils, chokes, resistors, transformers, and similar electronic components. Its main feature is said to be adjustable flexibility. Properties of the cured material reportedly can be varied from a semirigid casting to a flexible sealant by varying the proportions of the two parts. The cured material is stated to retain superior impact resistance and adhesion over a broad temperature span. Merco Products Div., Metachem Resins Corp., 530 Wellington Ave., Cranston 10, R. I.

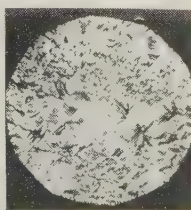
Print No. Ins. 107 on Reader Service Card

Fine Crystalline Structure Improves Nylon

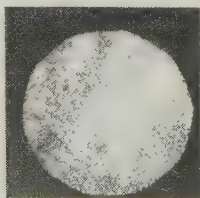
Better uniformity of all properties



TYPE 6/6 NYLON



TYPE 6 NYLON



FOSTA NYLON
MODIFIED TYPE 6

regardless of section, improved molding characteristics, and minimum moisture distortion are direct gains said to result from a fine crystalline spherulitic nylon. The new "Fosta" nylon modified type 6 (Fosta Nylon 62A-SK) is stated to show maximum spherulite size of 2.1 microns. This fine crystalline structure reportedly may be obtained without special care or processing during molding. Recent tests showed a maximum of only 1% increase in linear dimensions from water absorption in 62A-SK. Foster Grant Co. Inc., Leominster, Mass.

Print No. Ins. 108 on Reader Service Card

New Urethane Wire Dip Enamel

A new polyurethane wire enamel specifically designed for dip application, "Carthane" 8063, is said to have outstanding ease of application. High quality wire, fully meeting specifications, reportedly has been produced over a baking range of 100°F . The new enamel is claimed to have a higher solids content at equal viscosities than any urethane enamel previously produced (33% solids content)—such a solution has a viscosity of only 32 centipoises. Good builds, therefore, are easy to obtain, solvent losses can be reduced, and wire output can be increased. Other features claimed for Carthane 8063-coated wire include easy solderability (twice as fast as that required for conventional urethane enamels), and superior cut-through temperature (-480°F for No. 38 AWG single with 1000-gram load). The enamel is also said to be exceptionally resistant to solvents, including acetone, and to readily pass standard tests for adherence, flexibility, abrasion, aging, and other factors. Data sheet CPP No. 8 available. The Carwin Co., Polymer Products Div., North Haven, Conn.

Print No. Ins. 109 on Reader Service Card

All-Purpose Epoxy-Glass Laminate For Uniform Etched Circuitry

A new "Micaply" epoxy laminate, Grade EG-761-T, is designed primarily for plated-through printed circuits. It is a non-adhesive, all-purpose laminate said to retain the best electrical, mechanical, and machining properties and to exhibit no transfer of fabric weave pattern through the

copper surface, providing a glass-smooth finish that makes satisfactory and durable electro-plating easy to attain. A more uniform bond with the plating material, greater consistency in the electrical values through the circuit, and reduced possibility of degradation due to processing are other advantages stated to result from the smooth surface. Grade EG-761-T meets or exceeds the requirements of existing military, commercial, and company specifications for G-10 or type GEE epoxy glass laminates. The Mica Corp., 4031 Elenda St., Culver City, Calif.

Print No. Ins. 110 on Reader Service Card

New Insulating and Protective Coating Absorbs Ultraviolet Rays

A new insulating and protective coating reportedly absorbs ultraviolet rays and has excellent electrical and weather resistance properties. Humi-Seal type X-242 is a fast-drying coating which becomes tack-free within ten minutes. It may be used in the manufacture of semiconductor devices which are affected by the ultraviolet rays from fluorescent lights. The maximum operating temperature of Humi-Seal X-242 is 130°C . It is stated to have a dielectric strength of 1700 vpm, a dielectric constant of 2.3, a refractive index of 1.477, and volume resistivity of 10^{15} ohm-cm. Humi-Seal type X-242 may be applied by brush, dip, or spray. It dries and cures at room temperature. Columbia Technical Corp., 61-02 Thirty-first Ave., Woodside 77, N. Y.

Print No. Ins. 111 on Reader Service Card

Polyester-Glass Cable Tape with Improved Low Loss Characteristics

Greatly improved low loss characteristics reportedly are provided by a new varnished polyester-glass cable tape (No. 76554) designed specifically for laminated cable constructions. Tests are said to show that at 100°C the tape's power factor rises to only approximately 1/3 that of conventional varnished cambric and that its dielectric strength is unimpaired by normal application stretch. As a result, it is stated that construction thickness can be up to 20% less than that required with varnished cambric. Other features claimed include in-

Another product of Spaulding research, new Spauldite Grade XXXP-770 makes simplified design of many electrical and electronic components a reality.

It is low in cost, self extinguishing, has good moisture resistance, can be cold punched and has high mechanical and electrical properties.

Shown here in a flyback transformer application for television receivers, XXXP-770 is especially suited for all uses in which fire is a hazard.

Contact Spaulding for more information on XXXP-770 or Progress Reports on other new Spaulding Applications for Industry.



NEW SPAULDITE XXXP-770

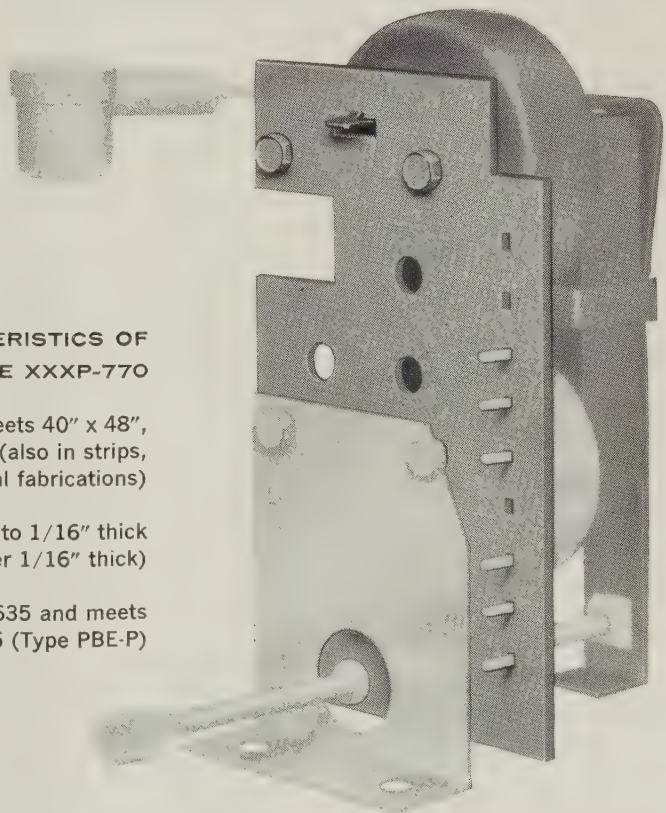
- COLD PUNCHING
- FLAME RETARDANT AND LESS EXPENSIVE THAN PAPER BASE EPOXIES

CHARACTERISTICS OF SPAULDITE XXXP-770

Furnished in sheets 40" x 48", thicknesses 1/32"-3/16" (also in strips, blocks or special fabrications)

Cold punching up to 1/16" thick
(Warm punching over 1/16" thick)

Flame Retardant — ASTM-D635 and meets UL requirements and MIL-P-3115 (Type PBE-P)



creased flexibility, no need for slipper compound in most cases (slippage is allowed by a high oil content), high resistance to moisture, and ability to withstand assembly punishment (permits it to be used in all cable taping machines). Insulating Materials Dept., General Electric Co., Schenectady 5, N. Y.

Print No. Ins. 112 on Reader Service Card

Glass-Ceramic Cement for 425°C

A new glass-ceramic cement for the electronics industry has been developed to seal glasses and other materials with thermal expansions between 80 and $92 \times 10^{-7} \text{cm/cm/}^\circ\text{C}$. Designated "Pyroceram" No. 89, it has electrical properties similar to those of Pyroceram cement No. 95, which seals materials with higher expansions. However, at elevated temperatures the 89 cement is said to be stronger. The new cement fires at approximately 450°C . The resulting seal reportedly is serviceable up to about 425°C . The cement seals electronic glasses, metals, ceramics, and combinations of these materials. Electrical properties cited include the following: at 100 kc, loss tangent at 25°C is .001; at 230°C it is .014; at 373°C it is .250. Under the same conditions, dielectric constant is 19.8, 21.8, and 25.6, respectively. Log d-c resistivity is 8.6 at 250°C and 7.05 at 350°C . Specific gravity after sealing is 6.3. Average modulus of rupture is 6000 psi at 25°C and 4800 at 400°C . The cement is a finely powdered glass applied in a low viscosity vehicle to the sealing area by dipping or pressure flow. Upon firing, it partially crystallizes, resulting in a vacuum tight, devitrified seal. Industrial Bulb Sales Depts., Corning Glass Works, Corning, N. Y.

Print No. Ins. 113 on Reader Service Card

Polysulfide Potting Compound

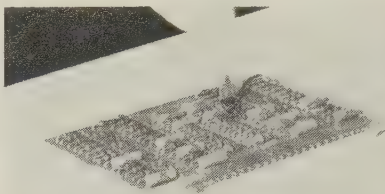
A recently developed polysulfide-based, equal part potting compound is said to exhibit temperature resistance of -65°F to 275°F (-53.9°C to 135°C) and to have very good fluid resistance as well as outstanding electrical properties. Known as Pro-Seal 767, the potting compound reportedly meets or exceeds the minimum requirements of MIL-S-8516-B. Coast

Pro-Seal & Mfg. Co., 2235 Beverly Blvd., Los Angeles 57.

Print No. Ins. 114 on Reader Service Card

Flexible Epoxy for Coating Printed Circuit Boards

A new, 100% solids, flexible epoxy resin is specifically formulated for the coating of printed circuit boards. Designated TC-3047, it is designed to seal and reinforce components, to prevent insulation failure due to moisture or dust contamination, to im-



prove thermal shock resistance, and to act as a vibration damper. Delicate or heat sensitive components reportedly will not be damaged by the extremely low exotherm of the material. TC-3047 can be brushed on in varying thicknesses of from 2 to 20 mils in one application. Malfunctioning components can be replaced or repaired by softening the TC-3047 around the defective component with the tip of a 100 watt soldering iron. Reworked area can then be recoated. Properties (approximate) reported include a dielectric constant of 3.2; dielectric strength of 1000 vpm; arc resistance of 80 seconds; high resistance to oil, JP fuel, and most common chemicals; excellent elastic memory; will not support fungus; low shrinkage; and negligible moisture absorption. Chemical Div., Electronic Production & Development Inc., 501 N. Prairie Ave., Hawthorne, Cal.

Print No. Ins. 115 on Reader Service Card

Two Epoxy Dip Coatings For Electronic Components

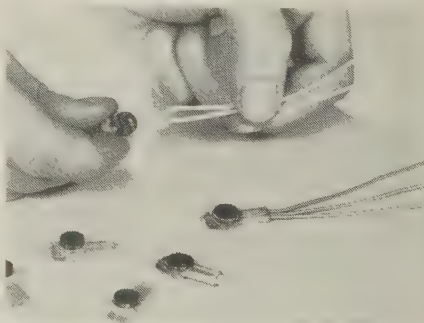
Two new epoxy compounds are designed for dip coating electronic components. *Meta-Gel 103* is a 100% solids, solvent-free, single component (no hardener required) epoxy dip coating said to be particularly suited for encapsulation of mica and ceramic capacitors for MIL-C-105 requirements. Unexcelled electrical properties and excellent environmental endurance are claimed. *Meta-Gel 151* is designed for dip coating heat-sensitive electronic components such as

rectifiers, capacitors, and resistors, and is said to be ideal for any electronic coating applications where low temperatures are required. The solvent-free, 100% solids, two-part epoxy compound reportedly does not sag or run even on vertical surfaces. Data and application methods bulletins available. Mereco Products Div., Metachem Resins Corp., 530 Wellington Ave., Cranston 10, R. I.

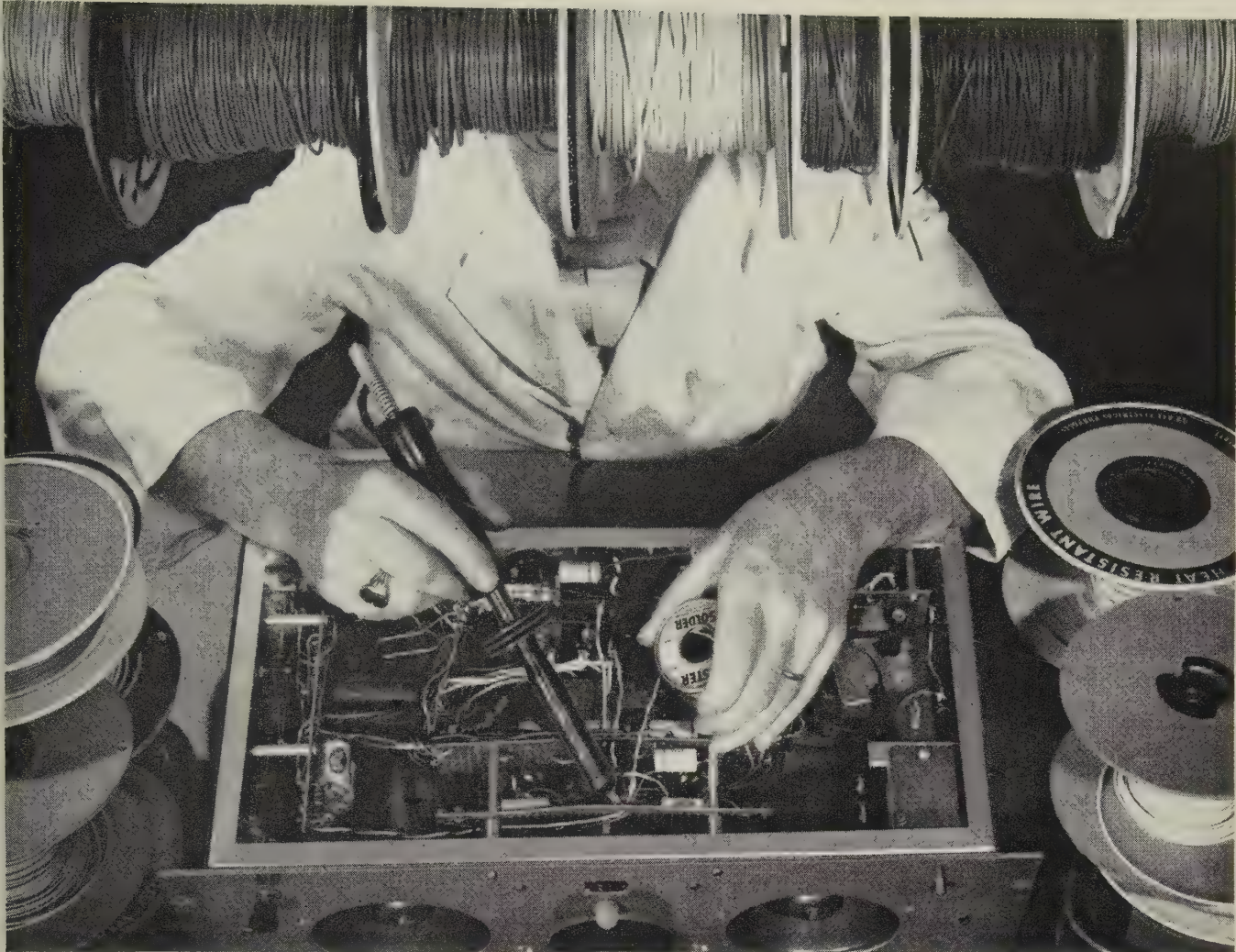
Print No. Ins. 116 on Reader Service Card

Self-Stripping, Moisture-Proof Connector for Communication Wire

A self-stripping communication wire connector, stated to be the first ever developed for the telephone, communications, and signaling industries, is also self-sealing and pre-insulated. The "Scotchlok" brand electrical connector (type UR) splices, insulates, and moisture-seals in two steps, reportedly saving up to 1/3 to 1/2 the time required for conventional twist and sleeve splices. The connector is designed to accommodate any 2 or 3 wire combination of No. 19 to No. 26 AWG solid or No. 20 to No. 26 AWG stranded wire, and to handle all common types of insulation, including plastic, rubber, enamel, and "Teflon." The resulting splice is said to be the functional equal of twist and solder jointing methods, with an average



pullout resistance equal to 95% of wire breaking strength. The unit is made of a transparent thermoplastic material, filled with silicone grease, and incorporates a metal finger-like connector element. In use, wires are inserted into the connector and secured simply by squeezing a button into the connector sleeve. As the button is depressed, the finger-like connector element strips the insulation and grips the conductors, providing a strong mechanical and electrical joint. The thermoplastic sleeve insulates and protects the splice, and the fac-



For vinyl insulation that holds up under rugged service . . .

MONOPLEX & PARAPLEX PLASTICIZERS

The plasticizers listed below not only maintain very good electrical properties in your vinyl insulation, but they also stay **in** the insulation and keep its physical properties from deteriorating when the going gets rough. For instance, here are some performance characteristics of vinyls using these plasticizers . . . excellent retention of physical properties on exposure to high temperatures . . . very low plasticizer volatility . . . high resistance to migration into lacquers, baked enamels, rubber, and polystyrene . . . exceptional resistance to plasticizer extraction by water, soapy water, and oil. Also, note the key uses for the individual grades:

MONOPLEX S-90E—applications requiring retention of resistivity, tensile strength, and elongation after long-term high-temperature aging (either dry, immersed in water, or exposed to high humidity).

PARAPLEX G-54—standard appliance wire, including 105°C insulation. Has particular merit wherever 1) retention of compatibility under high humidity exposure and 2) freedom from plasticizer migration into polystyrene, rubber, lacquers, and other coatings are required.

PARAPLEX G-62—provides stabilization against heat. Ideal for high-temperature insulation. Also can be used with general purpose plasticizers to improve durability of lower-cost wire such as extension cords. Outstanding for use with PARAPLEX G-54 and MONOPLEX S-90E for improved stabilization of high temperature insulation.

We will be glad to send more detailed technical information and literature on these plasticizers. Also ask for our 13-page booklet *What You Should Know about PARAPLEX and MONOPLEX Plasticizers*.

MONOPLEX and PARAPLEX are trademarks, Reg. U.S. Pat. Off. and in principal foreign countries.



Chemicals for Industry

**ROHM & HAAS
COMPANY**

THE RESINOUS PRODUCTS DIVISION

Washington Square, Philadelphia 5, Pa.

Print Ins. 37 on Reader Service Card

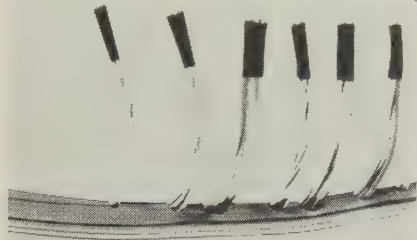
Insulation, August, 1960 53

tory-installed silicone grease moisture-seals the joint. Dept. WO-225, Minnesota Mining and Manufacturing Co., 900 Bush Ave., St. Paul 6, Minn.

Print No. Ins. 117 on Reader Service Card

Tapered Zippertubing Jacket for Cables of Decreasing Diameter

A new tapered Zippertubing offers a tight fitting cable jacket for cables of decreasing diameters due to branch-outs. Wires can be pulled through perforations of the tapered Zippertubing to permit attachment to termination points without special tools. Time and labor savings up to



50% are reported. The jacket is supplied according to customers' specifications and in colors matching all types of cable jackets. The Zippertubing Co., 752 S. San Pedro St., Los Angeles 14.

Print No. Ins. 118 on Reader Service Card

Glass-Mica Components with Hermetic Seal Between Metal Inserts

A hermetic seal can be provided between metal inserts integrally molded into "Havelex" glass bonded mica components. Intricate part designs and close tolerances are said to be possible. Photo shows example of a molded base for a thermostatic motor protection unit. In it, five

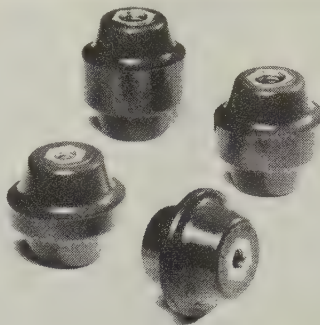


metal inserts (three terminals, a mounting post, and the outer ring) are hermetically sealed with the Havelex body. These development parts reportedly evidenced no measurable helium tracer leakage on mass spectrometer test equipment operating to a sensitivity of 1×10^{-9} cu cm/sec. Haveg Industries Inc., Taunton Div., 336 Weir St., Taunton, Mass.

Print No. Ins. 119 on Reader Service Card

Center Post Insulators Molded of Fiber Glass Reinforced Polyester

Four new center post insulators, in heights of $1\frac{1}{2}$ ", $1\frac{3}{4}$ ", 2", and $2\frac{1}{4}$ ", are molded of fiber glass reinforced polyester with threaded hole diameters through $\frac{5}{8}$ ". Advantages cited



include high impact strength, dimensional accuracy, UL-recognized flame retardance, and low cost. The Glastic Corp., 4321 Glenridge Road, Cleveland 21, Ohio.

Print No. Ins. 120 on Reader Service Card

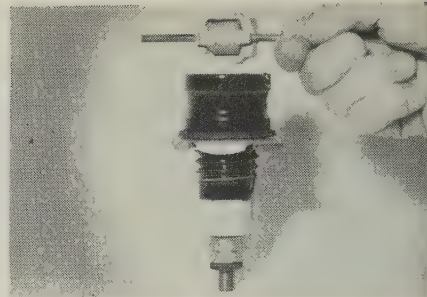
UL-Approved "Teflon" Insulated Wire

Underwriters Laboratories approved Teflon insulated wire is now available with a standard 10-mil wall of extruded Teflon TFE insulation on silver or nickel plated solid or stranded conductors. It is said to be particularly suited for use in commercial computers and business machines. Tensolite Insulated Wire Co. Inc., West Main St., Tarrytown N.Y.

Print No. Ins. 121 on Reader Service Card

New Threaded Porcelain Secondary Transformer Bushing

A new low voltage transformer bushing is designed for internal mounting with a single screw-on type retaining nut. The bushing body is high voltage porcelain grooved to prevent twisting of the terminal or rotation of the bushing on the transformer. The lower end of the porcelain is threaded for mounting of the bushing on the transformer case. Simply tightening the spring steel nut onto the threaded shank of the bushing is said to make a tight, leak-proof installation. Only two loose parts are required for mounting each bushing—a cork-Buna N flange gasket for use with askarels or transformer oil, and the retaining nut. The new bushings are recommended for distribution transformer applications to 1.2

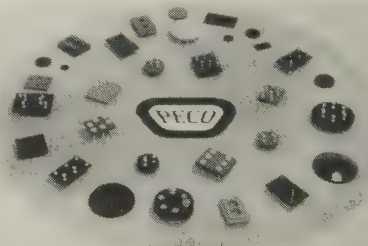


kv with a choice of two terminals, for conductor sizes No. 8 to aluminum equivalent of 2/0 or No. 6 to aluminum equivalent of 4/0. Bulletin No. 546 available. Lapp Insulator Co. Inc., Insulator Div., Le Roy, N. Y.

Print No. Ins. 122 on Reader Service Card

Epoxy Molded Headers for Plug-Ins

Epoxy molding compounds are used to manufacture a wide choice of headers with pins or terminals for plug-in applications or wire leads for soldered connections. The headers fit standard epoxy component cases, may be used with metal enclosures, or may be incorporated in an assembly which will be potted or cast-molded into a plug-in module. This latter application ensures proper location of the pins or terminals in the final package and simplifies handling of the unit during assembly prior to the potting or casting operation. Pin lay-outs are available to fit standard seven-pin and nine-pin miniature sockets or stand-



ard printed-circuit board spacing. Simplified soldering operations without danger of cracking or warping are said to result from the high temperature resistance and excellent dimensional stability of the epoxy. Materials such as phenolic or diallyl phthalate may be used in place of epoxy where their material characteristics are preferred. Plastronic Engineering Co., 721 Boston Post Rd., Marlborough, Mass.

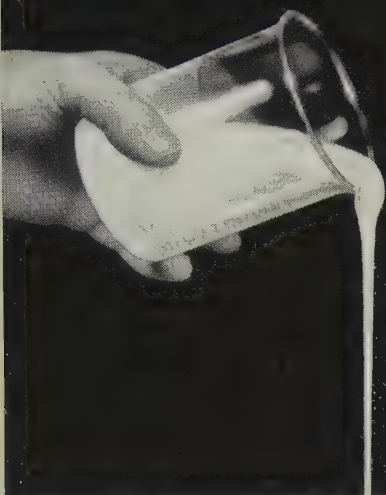
Print No. Ins. 123 on Reader Service Card

Slotted "Teflon" Terminal For Header Applications

A Teflon terminal with a .030" di-

General Electric RTV*

*Room
Temperature
Vulcanizing



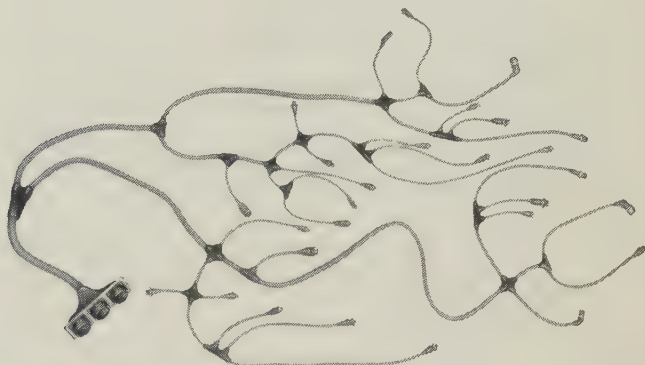
The latest addition to General Electric's RTV family offers lower viscosity than any other available silicone rubber compound — a typical viscosity of 120 poises. Easily pourable, it flows freely in and around intricate contours, making it ideal for protecting electrical and electronic components.

With RTV's new low viscosity, the range of G-E RTV compounds now extends from 120 to 12,000 poises. You can now meet your specific requirements by selecting from several G-E RTV compounds, all of which offer room temperature cure, heat and ozone resistance, and good electrical properties. Write for a free test sample, briefly describing your application.

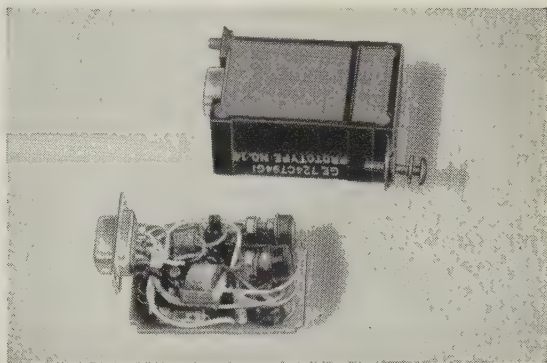


liquid silicone rubber

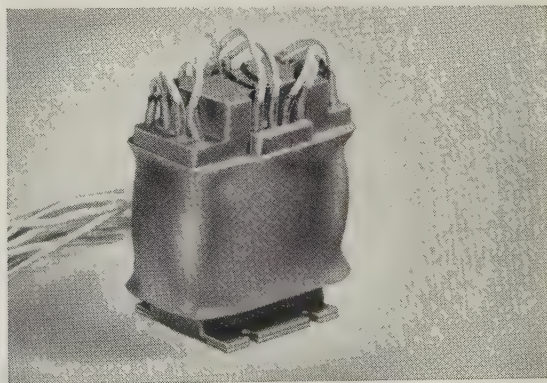
New low viscosity for easier encapsulation and impregnation



General Electric silicone rubber used extensively by Aerojet-General Corp. for the Titan ICBM's propulsion-system wiring harness. Tubing is heat-cured silicone rubber, molding G-E RTV and wiring insulated with silicone rubber — all chosen for their stable insulating properties, resistance to temperature extremes and weathering, and stability in storage for many years.



Sight amplifier module potted with RTV by the Armament and Control Section of G.E.'s Light Military Electronics Department. Used on the Lockheed CF-104 and F-104G jet aircraft, RTV provides mechanical support and vibration damping, protects unit against moisture and ozone. (Bottom photo shows module before potting.)



High-voltage, high-altitude transformers from Laboratory For Electronics, Inc. are encapsulated with General Electric RTV to meet MIL-T-27A specs. This prevents flashover at maximum ratings of 2200 volts rms and 80,000 feet. General Electric RTV was selected for its good heat transfer, low viscosity and mechanical strength.

GENERAL ELECTRIC

Silicone Products Department, Waterford, New York

Print Ins. 38 on Reader Service Card

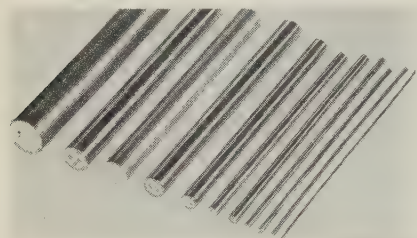


meter through-hole features a slotted terminal top to facilitate bringing of the lead through the terminal for wrap-around connection. Designed for header applications in potted components, Type RFT-SM-40-SL is said to be particularly suitable for potentiometer requirements. Sealectro Corp., 139 Hoyt St., Mamaroneck, N. Y.

Print No. Ins. 124 on Reader Service Card

Metal-Sheathed, Ceramic-Insulated Thermocouples

A complete line of metal-sheathed, ceramic-insulated thermocouples designed for temperature sensing applications are claimed to feature easy attachment to thermocouple heads or connectors; high resistance to thermal shock and severe pressure; can be imbedded or cast in virtually any material; make protective tubing un-



necessary; excellent thermal conductivity; small size; and light weight. Several standard and special junctions available; obtainable in a variety of configurations and standard cold end terminations. Catalog supplement No. 161 available. Harco Laboratories Inc., New Haven, Conn.

Print No. Ins. 125 on Reader Service Card

New Cable Jacketing Process Allows Very Short Runs

A new process for manufacturing both neoprene and polyvinyl chloride jackets for multi-conductor cables reportedly places no restrictions on the minimum length of the run (a single

foot is possible), or on the number of cable conductors specified as long as the ID does not exceed 4". The performance characteristics of the jacketing process are expected to meet, and in many cases surpass, the required customer standards. Alpha Wire Corp., 200 Varick St., New York 14.

Print No. Ins. 126 on Reader Service Card

Metalized Ceramic Transformer Terminals

A new line of custom fabricated metalized ceramic transformer terminals consists of feed-through and standoff types made in both steatite and alumina ceramics, glazed or un-



glazed. A band of metal coated on the base of the terminal, or a metal flange, reportedly permits the transformer manufacturer to hermetic seal the component into his transformer case by either soft soldering or silver brazing methods. Available with solder lug or threaded bushing for connection of leads. Voltage range is up to 22,500 v. Metalizing Industries Inc., 338 Hudson St., Hackensack, N. J.

Print No. Ins. 127 on Reader Service Card

Epoxy Bushings with Integrated Rectifier Filament Transformers

Integrating the rectifier filament transformer into a solid epoxy resin body is stated to provide a compact standoff bushing with rugged characteristics and low power losses. Three available types of filament transformers cover most of the commonly used rectifier types. Type CRF-150K (illustrated, left) provides a 150 kv peak isolation in air or oil. The bushing is 22" high with an 11" OD. It contains a filament transformer with a primary designed for 100 to 135 v 60 cps power and a secondary, supplying from 20 v at 32 amp to 5 v at 32 amp. Type CRF-75K (illustrated, right) provides a 75 kv peak isolation in air or oil in a unit 11"

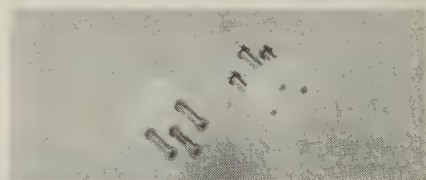


high x 7" OD max. The filament transformer has the same primary arrangement but a secondary range from 5 v at 7 amp to 2.5 v at 14 amp. Similar bushings with special power requirements can be produced as required. Components for Research Inc., 979 Commercial St., Palo Alto, Cal.

Print No. Ins. 128 on Reader Service Card

"Teflon" Insulated Transistor Holders

A new series of Teflon insulated holders for transistors, designated as TC-300, have been designed for three-lead transistors and embody the "Press-Fit" technique for fast and

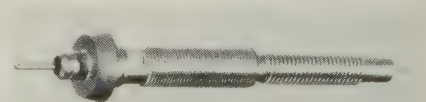


economical chassis insertions. The extra long terminal acts as a heat sink reportedly permitting soldering of the transistor in place with greatly reduced danger of damage to the transistor elements. Sealectro Corp., 139 Hoyt St., Mamaroneck, N.Y.

Print No. Ins. 129 on Reader Service Card

High Temperature Ceramic-to-Metal Hermetic Sealing

High temperature ceramic-to-metal hermetic sealing to standard and unusual specifications is available in



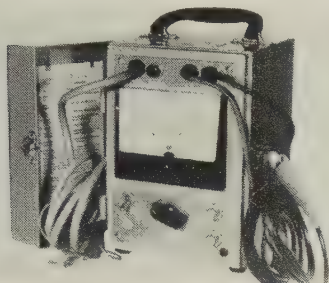
standard materials and configurations, and also in various alloys and unusual shapes and sizes. Device Seals Inc., 7235 Radford, North Hollywood, Cal.

Print No. Ins. 130 on Reader Service Card



**Portable Unit for High Voltage
D-C Insulation Breakdown Tests**

A new high voltage d-c dielectric strength tester, the D-C Hypot Jr., weighs only 20 lbs and operates from 110 v a-c. It is designed for production and quality control testing of electrical equipment, components, and assemblies such as motors, transformers, cables, bushings, and insulating material samples. Operation is virtually automatic. Three models are offered, with output continuously variable from 0-1500, 0-2500, and 0-5000 v d-c. The "breakdown" light

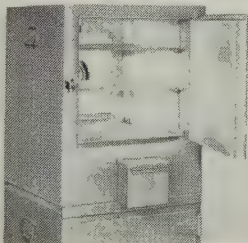


indicates arcing, corona, and insulation breakdown, while a second light indicates when the insulation leakage current exceeds a predetermined maximum, adjustable from 300 μ a to 3 ma. Priced from \$285. Bulletin 5-1.4 available. Associated Research Inc., 3777 W. Belmont Ave., Chicago 18.

Print No. Ins. 131 on Reader Service Card

**Lab Oven for Accurate Control
Of Temperature to 550°F**

New design is said to provide dependable heat control accuracy up to 550°F in an electric laboratory oven for heat testing and such other uses as drying and curing, aging processes, and preheating plastic materials. The model 203-6 oven is built so that ovens can be stacked one upon another in a floor space of 27" x 22". Other features reported are automatic control, a high velocity fan that diffuses heated air evenly and completely through the work chamber, safety circuit breaker, and complete insulation. Heating system is a low



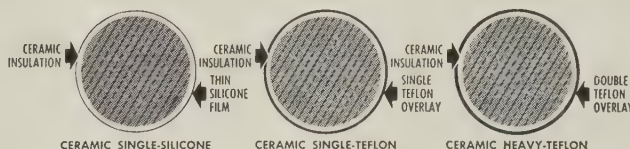
**THESE ARE SPRAGUE'S TWO OUTSTANDING
HIGH-TEMPERATURE MAGNET WIRES**

Tetroc®

FOR CONTINUOUS OPERATION AT
HOTTEST SPOT TEMPERATURES
UP TO 200°C

Cerroc®

FOR CONTINUOUS OPERATION AT
HOTTEST SPOT TEMPERATURES
UP TO 250°C

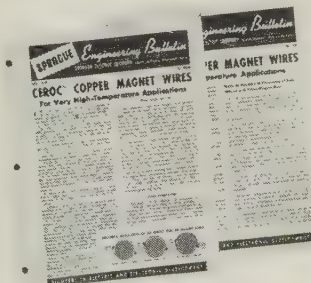


ENLARGED CROSS-SECTIONS OF CEROC® COPPER MAGNET WIRE

Sprague offers you a choice of 2 truly high temperature magnet wires: For continuous operation at hottest spot temperatures up to 200°C (392°F) and up to 250°C (482°F) for short periods of time—depend upon TETROC—an all Teflon-insulated wire available in both single and heavy coatings.

CEROC is Sprague's recommendation for continuous operation

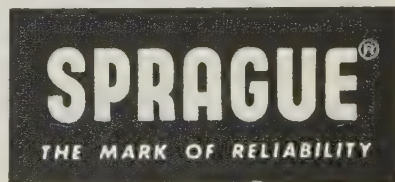
at hottest spot temperatures up to 250°C (482°F) and up to 300°C (572°F) for short periods of time. Cerroc has a flexible ceramic base insulation with either single silicone or single or heavy Teflon overlays. The ceramic base stops "cut-through" sometimes found in windings of all-fluorocarbon wire. Both Tetroc and Cerroc magnet wires provide extremely high space factors. ★ ★ ★ ★ ★



FOR COMPLETE DATA
WRITE FOR ENGINEERING
BULLETIN 405 (TETROC
WIRES) 400A (CEROC
WIRES).

SPRAGUE ELECTRIC COMPANY

441 MARSHALL STREET, NORTH ADAMS, MASS.



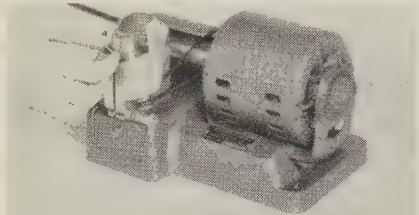
Print Ins. 39 on Reader Service Card

gradient type open coil (1500 watts, either 110 v 1/60 a-c or 220 v 1/60 a-c). Heat up time from room temperature to 550°F is stated to be 45 minutes with empty chamber. Despatch Oven Co., 619 S. E. Eighth St., Minneapolis 14, Minn.

Print No. Ins. 132 on Reader Service Card

Stripper for Ultra-Fine Wire

The model 89 TwinCone wire stripping machine is a bench unit that removes film insulations from ultra-fine sizes of single conductor wire leads by means of a pair of fiber glass stripping wheels. Model 89 is particu-

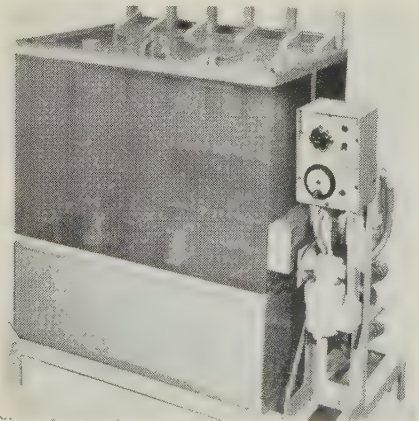


larly suited for stripping "Formvar" insulation from AWG #50 copper wire and for stripping enamel insulation from AWG #56 Nichrome wire. The machine reportedly strips wire leads to within 1/16" of component bodies. Carpenter Mfg. Co. Inc., P. O. Box 217, Highbridge Road, DeWitt 14 (Syracuse), N.Y.

Print No. Ins. 133 on Reader Service Card

Spray Etcher for Printed Circuits

New model 400 spray etching machine is designed to hold single-sided boards horizontally while etchant is sprayed vertically with a compound oscillatory motion. Line widths of 0.0005" etched in resolution tests, and precision etching of lines 0.002" on 0.004" centers accomplished with ease are among features claimed. The adjustable rack accommodates board sizes up to 20" x 30". Centre Circuits Inc., P. O. Box 165, 1101 N.

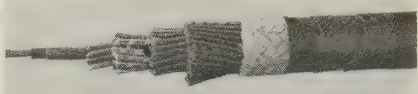


Atherton St., State College, Pa.

Print No. Ins. 134 on Reader Service Card

Cable with 80 Conductors

A single combination cable carrying up to 80 leads has been developed for high speed, automatic, electronically operated elevators which require an unusual number of conductors for control, lighting, ventilation, and communication purposes. This single cable eliminates the necessity of hanging groups of cables to serve



many functions and thereby also eliminates the danger of cable entanglement—a consideration of greatest importance in the modernization of old elevators with small shaftways. Bulletin available. Boston Insulated Wire & Cable Co., 65 Bay St., Boston 25, Mass.

Print No. Ins. 135 on Reader Service Card

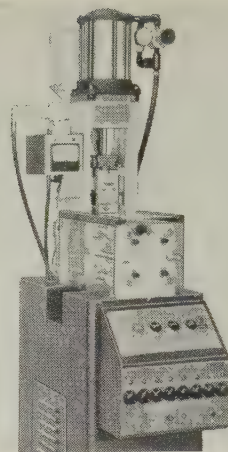
Improved Water-Based Fluxes

New, non-resinous, water-based fluxes feature instantly soluble and non-charring residues. Known as "Lonco" Organo-Fluxes, they are available in four grades that reportedly provide sufficient activity for any job, while holding residues to an absolute minimum for the soldering speed required. Typical applications include transistors, diodes, ceramic parts, magnets, refrigerator parts, prong soldering, roller soldering, terminal boards, connectors, and electrical components. London Chemical Co. Inc., Dept. IN-2, 1535 North 31st Ave., Melrose Park, Ill.

Print No. Ins. 136 on Reader Service Card

New Automatic Plastic Injection Molders

New plastic injection molding machine, the "Mini-matic," is a fully automatic, air-operated machine designed for production of specialized items in all thermoplastics up to 3/4 oz. The model 60AM80 features horizontal clamping with molds 6" x 5 1/8" x 5", four tie rod construction, and normal cycle time of 2 to 4 per min. Dry cycles are 480 per hr. Self-contained 8-element timer actuates

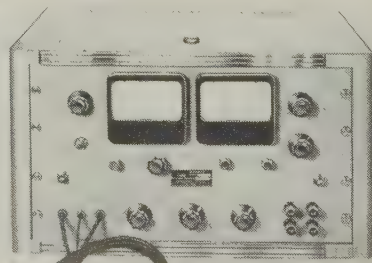


solenoid valves which control the cycle. All phases of the cycle are adjustable from 0 to 15 secs. Standard equipment includes indicating, time-proportioning temperature control to $\pm 1\%$ and a non-drool nozzle with heater band and heat control. Newbury Industries Inc., Newbury, Ohio.

Print No. Ins. 137 on Reader Service Card

Non-Destructive Tester for Dielectric, Resistance, and Leakage

New high potential test sets and megohmmeters for non-destructive testing in the electrical/electronic equipment manufacturing and quality control fields are identified as the 650 Series. These Megpots are said to offer accurate tests for dielectric strength, dielectric leakage, insulation resistance, surface resistance, and capacitor leakage. Dielectric strength test voltages cover the range from 0 to 5,000 v a-c or d-c. Insulation resistance test ranges are from 0.5 megohm to 10 million megohms at direct potentials continuously variable from 10 to 500 v d-c. Special circuitry is provided for the safeguarding of components undergoing hipot dielectric strength tests. The Megpot tests for dielectric leakage through the range from 20 μ a to 3 ma. Component leakage reactance equivalent to .0025 mfd reportedly can be tolerated at maximum voltage output. The megohmmeter is protected against external

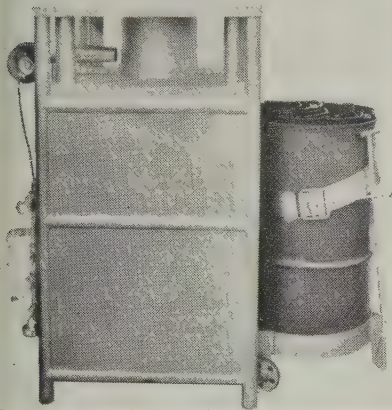


short circuiting and is readily calibrated with a built-in internal standard resistance. Megpot range accuracies claimed are 3% for a-c and d-c kv, 2% for d-c v, 3% and 5% for the megohm scales, and 10% max for leakage current control. General Hermetic Sealing Corp., 99 E. Hawthorne Ave., Valley Stream, L. I., N. Y.

Print No. Ins. 138 on Reader Service Card

Industrial Burner Removes Insulation from Armature and Wire

The 1960 model Grigg G-5662 industrial burner is said to provide a fast way to burn off insulation from armatures and copper wiring. The intense heat generated is stated to burn articles without smoke, odor, damage, or distortion and to meet strictest air pollution regulations. The unit consists of a burning drum cart and an after burner. It operates on com-



pressed air and gas—either natural or artificial—or on gas alone. Items to be burned are loaded in the drum and then wheeled into the burner. Bulletin 163 available. Grigg Specialty Tools, 8103 Marbrisa Ave., Huntington Park, Cal.

Print No. Ins. 139 on Reader Service Card

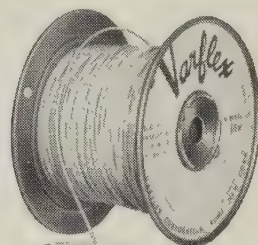
New Tool Speeds Stripping Of Polyethylene Insulation

A new tool for stripping thermoplastic insulation from power transmission cable is said to enable a line-man to strip high-density polyethylene insulation from hot-line cable in less than 5 min. It will remove 20/64 inches of insulation from conductor sizes No. 6 AWG to 750,000 CM. The tool is heated almost to red heat and fitted on the end of a fit-on pole



a silicone resin sleeving so flexible you can get it in spools or coils!

- **FLEXIBLE** — may be manipulated at all temperatures, -70° to $+500^{\circ}$ F. without cracking or checking. Dielectric strength remains even when sleeving is knotted.
- **HIGH DIELECTRIC STRENGTH** — up to 7000 Volts, depending on grade. Certified to meet government specification MIL-I-3190, latest revision.
- **RADIATION RESISTANT** — retains nonconductive properties under greater-than-average random intensities.
- **WIDE RANGE OF SIZES** — .010" I.D. to 3" I.D. Larger sizes possible.
- **COLOR CODED** — available in 12 brilliant, non-fading colors.
- **CHOICE OF LENGTHS** — for the first time, continuous lengths up to 5000 feet available, thus eliminating waste. 36 inch lengths where preferred.
- **DEPENDABLE, FAST DELIVERY** — Immediate delivery on standard items from stock . . . 48 hours for new production.



VARGLAS SILICONE RESIN "500" SLEEVING

Extremely useful where miniaturization increases heat and dielectric load on smaller wires, Varglas Silicone Resin "500" is only one of many sleeveings made by Varflex for this type of service. If you have a special insulating problem, call on our engineers for modifications of existing products, or for developmental work to meet stringent new requirements.

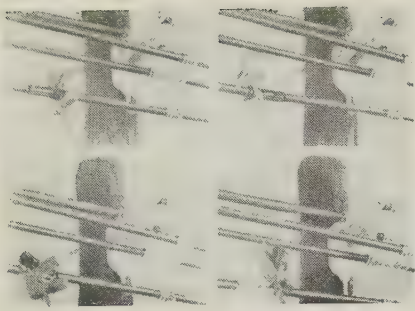
● Send for free test samples.

Varflex SALES CO., INC.
"Never Satisfied Until You Are"

Manufacturers of Electrical Insulating Tubing and Sleeving • 320 N. Jay St., Rome, N.Y.

Print Ins. 40 on Reader Service Card

Insulation, August, 1960 59



or universal hot-line pole. A modified V-shaped blade enables the lineman to make a clean circular cut through the insulation to the cable at each end of the section to be stripped out. Blades on either end of the V then are used to make linear cuts on opposite sides of the cable through the length of the section to be removed. A claw bar on the end of the tool is used to snap the loosened insulation away from the conductor. The insulation reportedly is stripped cleanly without application of torque or damage of any kind to the conductor or adjacent insulation. (See lower left portion each photo.) The stripping tool is 12" long, weighs about 3 lbs, and is made of copper-tin-nickel alloy. It comes with an asbestos handling glove and will sell at about \$20. Brochure available. Hendrix Wire and Cable Corp., Milford, N.H.

Print No. Ins. 140 on Reader Service Card
Laboratory Model Resin Fluidizer

A new "Micron" research model fluidizer is designed for research and development work on the application of plastic resins by the fluidized bed process. A gallon of resin is said to be more than enough to obtain dip depth in the fluidizer. Rugged and

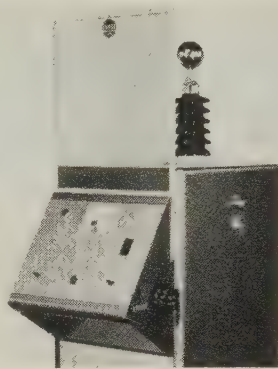


simple in construction, "Plexiglas" cylinder 5 $\frac{3}{4}$ " in diameter is divided into an operating section and a plenum chamber by a special diffusion plate. Height is 10 $\frac{3}{4}$ "; operating depth is 7 $\frac{3}{4}$ ". Michigan Chrome and Chemical Co., 8615 Grinnell Ave., Detroit 3, Mich.

Print No. Ins. 141 on Reader Service Card

High Voltage Sets for Insulation Breakdown and Leakage Tests

A new line of high voltage a-c test sets in deluxe console cabinets offer test potentials to 150 kv for a-c insulation breakdown and leakage current tests of large rotating equipment, line materials, short lengths of cable, and insulating materials. Models are avail-

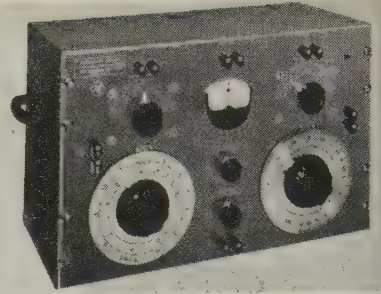


able with maximum outputs of 30 kv, 50 kv, and 75 kv, with ratings of 1, 2, and 5 kva. Features are incorporated to ensure safety. Bulletin 4-10.25 available. Associated Research Inc., 3777 Belmont Ave., Chicago 18.

Print No. Ins. 142 on Reader Service Card

Wide-Range Impedance Bridge

A new general-purpose impedance bridge, model 385, is designed to provide the broad range of measurements encountered in engineering laboratories, and is expected to find wide application in production test installations, repair and calibration facilities, and quality control departments. Portable, self-contained, and direct-reading, the instrument functions as a Wheatstone bridge (a-c or d-c) with a range of 0—1 megohm; a modified Wheatstone capacitance bridge (including D or DQ) with a range 0—100 μ fd, dissipation factor 0—1.0; or a Maxwell or Hay inductance bridge (including Q or DQ) with a range of 0—100 henries. Internal facilities are provided for all the above tests at 1 kc and at d-c (re-

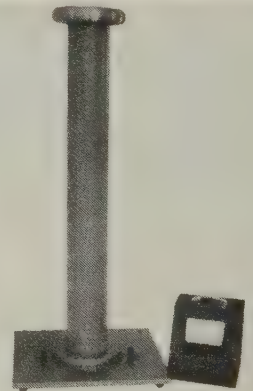


sistance only). Externally generated test signals from 60 cps—10 kc, as well as external d-c, can also be introduced. Bulletin 300059 available. The Winslow Co., 701 Lehigh Ave., Union, N.J.

Print No. Ins. 143 on Reader Service Card

200,000 Volt D-C Voltmeter

A 200,000 volt d-c voltmeter features two piece construction for remote metering, a convenient direct reading linear scale, rugged construction, conservatively rated components, safe operation, low drain, and reversible polarity. Composed of a high-voltage multiplier resistor in a tall "Bake-lite" tube and an indicating instrument in a small metal cabinet at ground potential, model M200DC kilovoltmeter has an input resistance of 2,000 megohms and will take any



overload of 150%. A large corona shield minimizes corona, and a neon gap overvoltage circuit protects the indicating instrument. Peschel Electronics Inc., Towners, Patterson, N.Y.

Print No. Ins. 144 on Reader Service Card

New Spray Equipment Cleans 900 Components per Hour

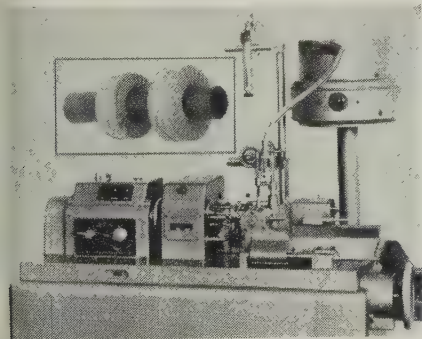
High-velocity spray-cleaning equipment, model RT-R-13-5, is stated to clean precision components at the rate of 900 parts per hour. Components are securely mounted around the periphery of a rotary turntable and automatically indexed to suc-

cessive high-velocity spray-clean operations. Fractionally distilled solvent is combined with heated and filtered air and directed against all areas. Oil, grease, silicone lubricants, rosin flux, fingerprints, lapping compounds, and other soluble and insoluble contaminants are reportedly safely and economically removed in seconds. An integral ventilation system exhausts all vapors during the cleaning process. Cobehn Inc., Passaic Ave., Caldwell, N.J.

Print No. Ins. 145 on Reader Service Card

Automatic Coil Winder Loads, Winds, Cements, Bakes, and Unloads

The new "Blu-Red" automatic winding machine will wind radio, TV, and communication type coils without human assistance. The only manual operations required of the attendant are that hoppers be kept filled with cores, and that wire spools be changed when their supply is exhausted. In operation, model KWA-58 coil winders will automatically: 1) start when melting temperature of wax or other



cementing agent is reached, 2) remove coil forms from the hopper-sorter and load them on a four station turret-type arbor, 3) anchor, wind, hot-wax, and cut off coil wire, 4) bake, and 5) unload the finished coil. Should the machine run out of material, or the wire break or run out, or if the temperature of the cementing agent falls below preset levels, the machine will automatically stop. Settings of coil width, crossover rate, and



CONVENTIONAL COIL

SPECIFICATIONS

NO. OF TURNS:
5400

WIRE SIZE 38

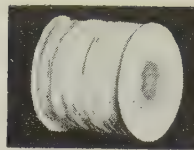
RESISTANCE:
625 Ω

BOBBIN MATERIAL:
NYLON

TEMPERATURE:
(NON-GASSING)
105°C

DIMENSIONS:
I.D.: 0.127"
O.D.: 0.497"
L.: 0.389"

TURBOPOWER* = > NI



TURBOPOWER* COIL

SPECIFICATIONS

NO. OF TURNS:
6500

WIRE SIZE: 37

RESISTANCE:
625 Ω

BOBBIN MATERIAL:
MYLAR

TEMPERATURE:
(NON-GASSING)
155°C

DIMENSIONS:
I.D.: 0.127"
O.D.: 0.497"
L.: 0.389"

TURBOPOWER* MEANS MORE AMPERE TURNS WITHOUT INCREASED COIL SIZE.

WHICH COIL WOULD YOU USE FOR YOUR CONTACTORS, RELAYS OR SOLENOIDS?



SEND US YOUR SPECIFICATIONS FOR FAST, EFFICIENT SERVICE ON TURBOPOWER* COILS.

REMEMBER — TURBOPOWER* CONSTRUCTION AND TECHNIQUES HAVE MADE POSSIBLE TURBOPOWER* 1000°F HI TEMPERATURE COILS.

FOR FREE BROCHURE USE NUMBER BELOW.

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CUMBERLAND 3-5191

*Patents Applied For

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Crocker, Burbank

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Large production capacity assures a wide selection of grades and thicknesses from .003" to .0095". Supplied in jumbo rolls or slit pads.

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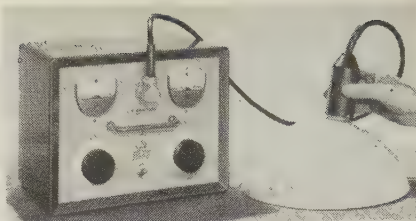
Insulation, August, 1960 61

progression are stated to be quickly and easily made from outside the machine, without calculation. Enamelled wire, cemented as wound, may be used. Associated American, 750 St. Ann's Ave., New York 56.

Print No. Ins. 146 on Reader Service Card

New Probes for Non-Destructive Tests Of Insulating Materials

New probes for use with the model 168, D-K analyzer allow non-destructive examination of many finished parts made of glass reinforced plastics and other insulating materials. The D-K analyzer is a direct reading instrument which measures the dielectric constant and dissipation factor of insulating materials. Since the probe can be placed directly on the surface of the part being tested, there is no need for sample preparation. This arrangement also facilitates rapid uniformity checks on large structures and sheets of insulating materials. The D-K analyzer is normally supplied with a probe for use with solid insulating materials. A liquid probe is also available for measurements on insulating oils, liquid resins, and



many other non-conductive organic liquids. Delsen Corp., 719 W. Broadway, Glendale 4, Cal.

Print No. Ins. 147 on Reader Service Card

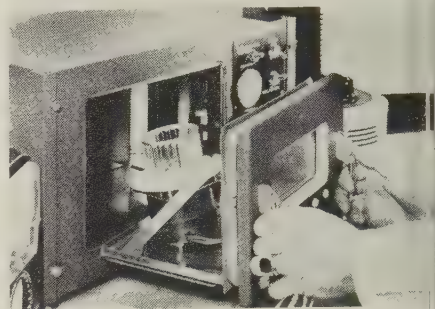
Improved Wheatstone Bridge

An improved model of the series 301 Wheatstone bridge is designed for outdoor use in environmental extremes and for portability. Housed in a waterproof aluminum case with removable cover and carrying strap, the instrument measures approximately 6" x 7" x 9" and weighs less than 9 lbs, including batteries. The instrument performs every routine bridge and loop test, including Wheatstone resistance tests; capacitance tests; and Varley, Murray, Hillearn, and Fither loop tests in addition to applications as a ratio or resistance box. It is said to have an accuracy of $\pm 0.10\%$ ± 0.01 ohm. Bulletin WI

40569-1 available. The Winslow Co., 701 Lehigh Ave., Union, N.J.

Print No. Ins. 148 on Reader Service Card Rapid Hot-Cold Cycle Testing Unit

A new compact temperature chamber for rapid hot-cold cycle testing of electronic devices and components is reported to automatically change tem-

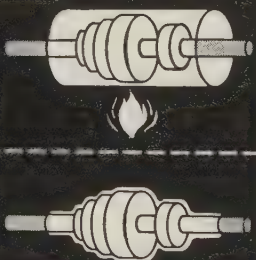


perature by up to 500°F in less than 5 min. The test chamber has a dynamic, thermocouple type control, with a special meter-relay circuit to maintain temperature stability within $\pm 1/2^\circ\text{F}$ throughout the unit's -100°F through 500°F range. The chamber provides a 10" x 7" x 7" test volume, is cooled by liquid CO₂, and weighs less than 50 lbs. Delta Designs Inc., 7460 Girard Ave., La Jolla, Cal.

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EXPANDED TEFLON® TUBING

THAT SHRINKS TO FORM A TIGHT FIT!



IT IS USED:

- To encase irregular shapes
- To protect electrical components
- To obtain tight fits over rollers and machined parts
- To join chemical tubes and metal fittings, etc.

PF Teflon-TFE tubing, which has been expanded mechanically, will recover the original dimensions promptly and clamp tightly to the inserted object when heat is applied. This new PF tubing:

- retains the outstanding electrical, mechanical and chemical properties of Teflon
- is available in all popular sizes, in both thin and standard walls, in 11 basic colors, printed and cut to the lengths you require
- can be made cementable



This new Teflon tubing will fit your critical requirements. Get complete details today. Write, wire or call.

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Bi-Seal Tapes
Coil Winding Machines
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Cotton Sleeveings
Commutators
Cuffed Insulating Papers
Extruded Plastic Tubings
Fiberglas Tapes, Cords and Sleeveings
Friction and Rubber Tapes
Insulating Varnishes and Compounds
Low-Pressure Laminates
Magnet Wire
Mica—Built-up and Raw
Motor Enamels
Pressure Sensitive Tapes
Safe-T-Seal
Silicone Rubber Fiberglas Tubings
Silicone Wedges
Silicone Varnish and Grease
Teflon Tape
Undercutting Machines and Saws
Varnished Sleeveings and Tubings—
Cotton, fiberglas and rayon
Varnished Cambric, Paper and Tapes
Vinyl Fiberglas Tubings and Sleeveings
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Booklet on Electrical Tape Tips For Savings and Service

A new booklet, "Useful Tips For Top Savings And Service," covers 24 specific tape jobs, from protecting electrician's tools to use of color-coded tapes to speed mass assembly of electrical components and products. The easy-to-read, clearly illustrated booklet also contains product information said to help in the selection of the most practical tape for any job. 12 pages. Johns-Manville, Dutch Brand Div., 7800 S. Woodlawn Ave., Chicago 19, Ill.

Print No. Ins. 201 on Reader Service Card

Booklet on Two Fast Curing Phenolic Molding Materials

Two new "Bakelite" phenolic molding materials with fast cure times and wide molding latitudes are described in molding technical release No. 40. One is a dust and fines free material designed for fast powder automatic molding, either cold or RF preheated. The other is supplied in Stokes granulation for plunger molding with high frequency preheat. Electrical and physical properties are listed and curves for minimum cure in plunger molding, preheating rate, range of plunger mold fill out, minimum blister free time, and rigidity at discharge from mold are included. 7 pages. Union Carbide Plastics Co., 30 East 42nd St., New York 17.

Print No. Ins. 202 on Reader Service Card

Laminated Plastic Fabrication Brochure

A new two-color brochure describes extensive facilities for fabricating

thermosetting laminated plastics. The brochure gives eight specific reasons, plus additional information, for using the fabricating facilities. 8 pages. Synthane Corp., Oaks, Pa.

Print No. Ins. 203 on Reader Service Card

High Density Polyethylene Uses, Properties, and Design Factors Brochure

Wide range of potential applications for high density polyethylene is illustrated by means of photographs of 101 of many commercially successful applications including wire insulation, television yoke, tube socket, insulated fittings, conductor spacer, and others. A brief description of the finished article and its method of fabrication accompanies each photograph. Complete physical, electrical, and chemical properties are tabulated. Also of interest is a section on design considerations such as section thicknesses, fillet radii, ribs, bosses, parting lines, undercuts, inserts, tolerances, decorating, and marking. 20 pages. W. R. Grace & Co., Polymer Chemicals Div., 225 Allwood Rd., Clifton, N. J.

Print No. Ins. 204 on Reader Service Card

Brochure Describes Silicone Uses in Electrical Appliances

How silicones aid electrical appliance design, performance, and manufacture is the subject of a new brochure. Titled "Extra Edge for Extra Sales," the comprehensive report describes practically all known appliance uses for silicone rubber, paints, fluids, lubricants, and electrical insulation. Photos, graphs, and tables illustrate how silicones aid in providing long maintenance-free service by improving mechanical dependability and electrical reliability. 8 pages. Dow Corning Corp., Midland, Mich.

Print No. Ins. 205 on Reader Service Card

Insulating Channel and Angle Stock Folder

Folder gives engineering dimensions and suggested applications for

GREEN PANTOGRAPH ENGRAVERS

● ELIMINATE DELAYS!

● KEEP YOUR OPERATING COSTS WHERE THEY SHOULD BE!

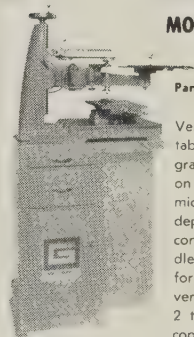


PORTABLE 40-POUND BENCH MODEL 106

You Make Your Own Engraved Nameplates!

Here is a speedy, economical 2 or 3-dimensional engraver used by thousands of dollar-conscious companies. It features 5 positive, accurate pantographic ratios; ball bearing spindle with 3 speeds up to 14,000 rpm. Is supplied with one copy carrier that accepts all standard master type sizes. Will actually work up to 10" by any width, Height of pantograph and position of cutter are continuously adjustable.

MODEL D-2 HEAVY-DUTY 2-DIMENSIONAL



Pantograph for milling, drilling and engraving.

Vertical adjustment of copy table automatic with Pantograph Features. unobstructed on 3 sides to take large work; micrometer adjustment for depth of cut; ball bearing construction throughout; spindle speeds up to 26,000 rpm for engraving or machining; vertical range over 10"; ratios 2 to 1 to infinity — master copy area 26" x 10".

NEW

MODEL D2-201 PNEUMATIC ATTACHMENT

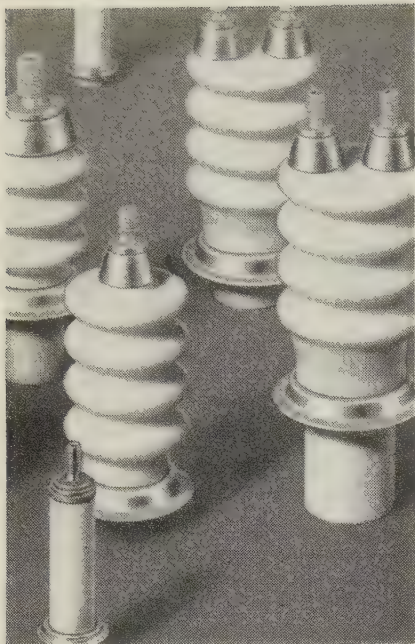


for use with Model D2 Pantograph Engraver to rapidly drill holes in printed circuits by tracing templates. Drills as many as 100 holes per minute. Equipped with foot switch; spindle air cylinder; regulating valve and pressure gauge; filter and oiler. It's ready to use as soon as it's attached to an air compressor

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low price**

Coors standard terminal insulators are regular stock items, available for immediate shipping. They are manufactured on a regular production basis, resulting in low manufacturing costs—and low prices.

Coors Terminal Insulators give you these important benefits:

1. High dielectric strength. 2. Excellent surface resistivity. 3. Great physical strength. 4. Permanent dimensional stability. 5. Extreme hardness. 6. Resistance to high temperatures. 7. High temperature subsequent brazes. 8. High thermal shock resistance. 9. Vacuum tight metal-ceramic assemblies.

Coors Offers Complete Ceramic Engineering Service.

Need special terminal insulators or metalized assemblies? A Coors Field Engineer is near you to give you ceramic design help. Call him today—or write for complete Technical Data Sheets on Coors Ceramic and facilities.

REGIONAL SALES MANAGERS

West Coast.....William S. Smith, Jr.
EM 6-8129—Redwood City, Calif.
Midwest.....John E. Marozek
FR 2-7100—Chicago, Ill.
Central.....Donald Dobbins
GL 4-9638—Canton, Ohio
East Coast.....John J. McManus
MA 7-3996—Manhasset, N.Y.
New England.....Warren G. McDonald
FR 4-0663—Schenectady, N. Y.
Southwest.....Kenneth R. Lundy
DA 7-5716—Dallas, Texas
Southwest.....William H. Ramsey
UN 4-6369—Houston, Texas



Print Ins. 46 on Reader Service Card

10 sizes of insulating channel and angle stock. The folder describes how the high strength fiber glass reinforced polyester shapes may be used as inexpensive replacements for stand-off insulators, wood members, and insulating metallic members. It illustrates how the shapes can serve as bus supports, enclosures, barrier ends, cable supports, insulating offsets, corner structures, wire raceways, stiffening bars, etc. Complete dimensions, specifications, and prices are included. 6 pages. The Glastic Corp., 4321 Glenridge Rd., Cleveland 21, Ohio.

Print No. Ins. 206 on Reader Service Card

Booklet on High Temperature Epoxy Adhesives and Potting Compounds

A new booklet describes five high temperature epoxy resin formulations said to be suitable for long-time service in the 450-500°F (232-260°C) range. Two of the formulations are potting compounds and three are adhesives. Advantages and disadvantages are discussed. Sixteen successful field applications are listed as representative. The adhesive characteristics are fully described and chemical resistance, electrical properties from room temperature to 600°F, complete physical properties of the cured systems, and handling characteristics are given. 8 pages. The Epoxylite Corp., P. O. Box 3397, South El Monte, Cal.

Print No. Ins. 207 on Reader Service Card

Bulletin on Small Coil Bobbins

Precision-molded coil bobbins available from stock and to specification are described in bulletin No. 3003. Detailed information on the engineering properties of the thermoplastics used—nylon, "Delrin," "Kel-F," and "Genetron"—and a special table on the electrical characteristics of nylon are included. 2 pages. Gries Reproducer Corp., 400 Beechwood Ave., New Rochelle, N.Y.

Print No. Ins. 208 on Reader Service Card

Comprehensive Manual on Plastic Extrusions

A comprehensive manual dealing exclusively with custom extrusions includes several articles dealing with

the design and application of extrusions, information about facilities available, up-to-date property tables, short descriptions of materials, and over 700 cross-sectional diagrams of extruded moldings. Available free by letterhead request only, to designers, engineers, and executives. 72 pages. Write to Dept. IN, Anchor Plastics Co., 36-36 36th St., Long Island City, 6, N.Y.

Pocket-Size Acrylic Plastics Handbook

Pocket-size handbook titled, "Fabrication of Plexiglas," has been reissued. Written in "How to . . ." form, with an easy-to-read format, the handbook counsels users on how to design for the acrylic, and how to form, cement, machine, finish, clean, maintain, and anneal it. It concludes with a guide to sources of supply for special fabricating equipment and materials. 34 pages. Commercial Plastics and Supply Corp., 628-30 Broadway, New York City.

Print No. Ins. 209 on Reader Service Card

Folder on Modified "Teflon" Parts

Fold-out brochure describes advantages of electrical and other parts made of "Fluorosint" TFE, a fluorocarbon base composition with other constituents added to provide improved mechanical and thermal properties while maintaining TFE's electrical and chemical characteristics. Sintered forms and mill sizes available are also listed and some parts are illustrated. 4 pages. Hallex Corp., 2120 Fairmont Ave., Reading, Pa.

Print No. Ins. 210 on Reader Service Card

Electrical Tape Case History

A concise, easy-to-read booklet gives valuable facts on the use of electrical tapes by Delta Air Lines. It shows how Delta was helped by utilizing the combination of protective properties in electrical tapes needed for trouble-free electrical line service in new DC-8 Jetliners. Johns-Manville, Dutch Brand Div., 7800 S. Woodlawn Ave., Chicago 19.

Print No. Ins. 211 on Reader Service Card

Brochure on Large Polyolefin Moldings

New brochure provides a comprehensive analysis of large polyolefin

moldings used for neutron moderation and shielding, for product prototypes, and for original equipment components. Three polyolefin types are covered: branch-type polyethylene, linear-type polyethylene, and polypropylene. Prices, detailed specifications, typical applications, and numerous illustrations are included. 4 pages. American Agile Corp., P. O. Box 168, Bedford, Ohio.

Print No. Ins. 212 on Reader Service Card

Engineering Data Chart of Thermosetting Laminated Materials

An engineering data chart of thermosetting laminated materials for use in the electronic, aircraft, missile, and related fields shows principal grades and properties, with illustrations of a variety of fabricated component parts and sub-assemblies. The chart lists mechanical, electrical, physical, and thermal properties for each of the laminates, base material and resin; and the general characteristics and applications. NEMA tolerances for laminated sheet materials in standard thicknesses are also given. 4 pages. Comco Plastics Inc., 98-34 Jamaica Ave., Richmond Hill 18, N.Y.

Print No. Ins. 213 on Reader Service Card

Complete Magnet Wire Catalog/Manual

New catalog WC-8289 covering a complete line of magnet wires includes full product descriptions with dimensional data and application information. A specially prepared guide is designed to give the design engineer a quick method of making preliminary selection of wires according to insulation and other requirements. It covers wire with such insulations as "Formex," "Alkenex," polyurethane, cotton, nylon, "Teflon," glass fiber, "Dacron" glass, asbestos, self-bonding, solderable, and others which are combinations of these insulations. Nomograms are included for computing cross-sectional areas, resistance, and weight of rectangular conductors, together with useful information on varnish properties, types and application, and radiation effects. 52 pages. Wire and Cable Dept., Chemical and Metallurgical Div., General Electric Co., Bridgeport 2, Conn.

Print No. Ins. 214 on Reader Service Card

Wire and Cable Catalog

New product catalog contains up-to-date engineering information on wire and cable. A self-reading code numbering system simplifies the identification of insulated wire and cable constructions. Tensolite Insulated Wire Co. Inc., West Main St., Tarrytown, N. Y.

Print No. Ins. 215 on Reader Service Card

"Teflon" Wire and Cable Brochure

A new brochure, DM-S-6001, gives specification details on Teflon-insulated hook-up wire for internal wiring of meters, panels, electrical and electronic equipment, and data on Teflon cable for high frequency equipment and radio-frequency transmission lines such as those employed in radar and communications systems. The folder supplies tabular information for rapid selection from a variety of components and configurations with class H Teflon jacketing capable of a working range of -90°C to 260°C . Conductor for the hook-up wire, conductor insulation, and many types of custom-designed cable items in continuous production are also described. 4 pages. Sequoia Wire & Cable Co., 2201 Bay Rd., Redwood City, Cal.

Print No. Ins. 216 on Reader Service Card

Catalog of "Teflon"-Insulated Terminals and Jacks

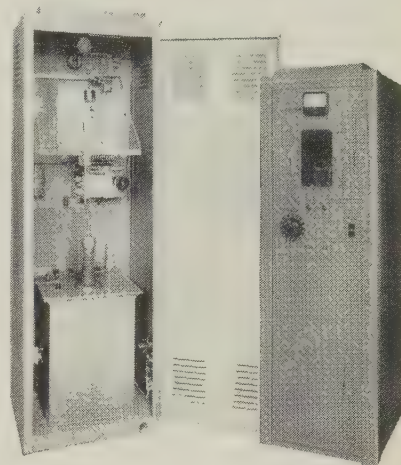
New catalog features over 100 different Teflon-insulated terminals and jacks. Standard, miniature, and sub-miniature units in 10 standard colors and many types are listed. Hiram Jones Electronics, 2313 W. Olive, Burbank, Cal.

Print No. Ins. 217 on Reader Service Card

Zippertubing Data

New brochure discusses and illustrates different types of Zippertubing constructions for harnessing and cabling, outlines advantages, and describes accessories. A chart of the different types available lists the basic ordering code for each, material, zipper type, construction, wall thickness, colors, MIL specs, temperature range, general comments, and whether it is flame and/or fungus resistant. The brochure also describes a machine for making cable with Zippertubing and

SAFE! SIMPLE! ACCURATE!



AC BREAKDOWN TESTERS

Complete line of units designed for testing in accordance with ASTM D-149 and Federal Spec. LP-406, Method 4031, used for determination of dielectric strength and breakdown voltage safely, simply and accurately in the laboratory or on the production line.

FEATURES

- Completely self-contained
- Automatic rate of voltage rise
- Plug-in test electrodes
- Retention of voltmeter reading after breakdown
- Dual range units available for maximum versatility, up to six voltmeter ranges

In addition to the standard models noted below, special models incorporating higher output ratings and a number of metering systems including primary metering, direct secondary metering, and digital output with recording can be provided.

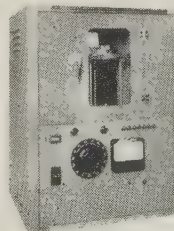
SINGLE

PA-5-152 PA-5-255
PA-5-155 PA-5-502
PA-5-252 PA-5-505
PA-50-1005

DUAL

PA-5-502/102
PA-5-252/052
PA-50-1005/205

ARC RESISTANCE TESTER



Used for measuring the ability of insulating material to withstand high-voltage low-current arcs. Supplied in conformance with ASTM D-495 and Federal Spec. LP-406 Method 4011.2. Simplified operation includes automatic stepping and timing, and improved electrode holder. Operable by unskilled personnel.

Complete catalog of Electrical Test Equipment available on request.

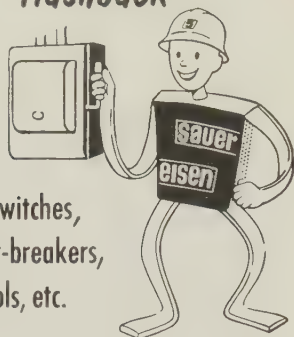


**Industrial
Instruments Inc.**

89 Commerce Road, Cedar Grove, Essex County, N. J.

Print Ins. 47 on Reader Service Card

Here's sure protection against flashback



on switches,
circuit-breakers,
controls, etc.

Sauereisen Insa-Lute Adhesive Cement No. 1 provides a ceramic-like coating that insulates electricity and withstands thermal shock. Easily applied by brushing or spraying. Hundreds of other uses.

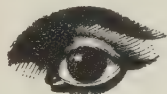
Ask for Data Sheets.

SPECIAL TRIAL ORDER \$4.40
for making tests under your own conditions Gallon Can

Sauereisen Cements Co.
Pittsburgh 15, Pa.

SAUEREISEN
Insa-Lute
CEMENT No. 1

Print Ins. 48 on Reader Service Card



LOOKING FOR AN ACID-ALKALI-SOLVENT RESISTANT RESIN?

Check.....PT-412

... a multi-purpose multi-polymer two-part system 80% resin solids. It flows readily, air cures, can be applied to any desired thickness. Particularly adapted to circuit boards or as a potting or encapsulating material.

Viscosity.....400 poises at 25°C

Taber Abrasion...1000 cycles per mil
1000 grams CS-17 wheel

Tensile Shear.....3000 psi at ambient

Water Absorption...2.5% at 212°F. 2 hrs.

Dielectric Constant.....3.2 60 cycles
ambient

Dielectric Strength....2000V per mil 60
cycles ambient

Temp. Range.....-60°F. to 250°F.

Pot Life 6 hours

PT-412 can be removed without carbonizing if soldering iron repairs are required. Want more information—prices—data sheets for your files? Please write ...

PRODUCT TECHNIQUES INC.

Problem-Solving Specialists

511 EAST 87TH PLACE

LOS ANGELES 3, CALIFORNIA

Print Ins. 49 on Reader Service Card

cabling accessories. 4 pages. The Zipertubing Co., 752 S. San Pedro St., Los Angeles 14.

Print No. Ins. 218 on Reader Service Card

Seal and Fastener Catalog

New catalog (No. 359A) describes and illustrates a complete line of high pressure, vibration resistant switch seals, boots, connectors, and fasteners. Applications are discussed and the U.S. Coast Guard Waterproof Standards are given. 16 pages. A.P.M. Corp., 252 Hawthorne Ave., Yonkers, N.Y.

Print No. Ins. 219 on Reader Service Card

Catalog of Sub-miniature "Teflon" Terminals

New catalog (No. T110) of Teflon-insulated standoffs, feed throughs, jacks, and plugs for HF, UHF, and VHF circuitry provides easy access to engineering and technical data such as voltage and capacitance MM-FD ratings. Catalog is designed with both purchasing agents and engineers in mind. 18 pages. Tri-Point Plastics Inc., 175 I. U. Willets Rd., Albertson, L.I., N.Y.

Print No. Ins. 220 on Reader Service Card

Data Sheets on "Teflon" Wire, Ribbon Cable, and Bonding Agent

New data sheets give general descriptions and backgrounds, list properties, and discuss standard and special constructions of corrosion resistant, abrasion resistant, and low density types of Teflon insulations on wire and ribbon cable. Construction details of different sizes of the insulated wire and cable are given. One sheet also covers a treatment for making Teflon bondable. 11 pages. W. L. Gore & Associates Inc., 487 Paper Mill Rd., Newark, Del.

Print No. Ins. 221 on Reader Service Card

Catalog of Electronic Jacks, Plugs, Connectors, Adapters, etc.

New catalog lists engineering data on electronic components such as miniature jacks, phono jacks, pin-jacks and plugs, banana jacks and plugs, microphone connectors, adapters, test leads, binding posts, hardware, etc. Zoron Inc., 612 W. Monroe St., Chicago 6.

Print No. Ins. 222 on Reader Service Card

Booklet on Wire Stripping Machines and Wheels

New booklet gives all specifications, prices, and ordering information on a line of power-driven wire stripping machines and wire stripping wheels for magnet wire, film insulated wire, PVC wire, "Teflon" wire, jacketed wire, coaxial cable, and other wires and cables. 8 pages. Carpenter Manufacturing Co. Inc., P. O. Box 217 DeWitt 14, N.Y.

Print No. Ins. 223 on Reader Service Card

Resins Chart

Revised standard resins wall-size chart covers physical and electrical properties as well as interesting features and uses of epoxy, polystyrene, polyester, and ceramic materials for encapsulation, casting, impregnating, coating, sealing, cementing, etc. Emerson & Cuming Inc., Canton, Mass.

Print No. Ins. 224 on Reader Service Card

Coaxial Connector Catalog

Complete technical data on the TNC series of coaxial connectors is contained in a new catalog. A functional diagram that illustrates the types and flow of connectors by various cable sizes is featured. Also included is a comprehensive presentation on calibrated reliability with accompanying graphs. 12 pages. Kings Electronics Co. Inc., 38 Marbledale Rd., Tuckahoe 7, N.Y.

Print No. Ins. 225 on Reader Service Card

Pamphlet on Ceramic Insulated Wire For High Temperatures, Nuclear Uses

Ceramic insulated wire for use in high temperature and nuclear applications is discussed in a new pamphlet. Many of the pitfalls that must be avoided if components are to operate successfully at 800° to 1200°F (427° to 649°C) are outlined. Separate sections are devoted to the physical and electrical properties of the insulation; conductors; and potting, sealing, and termination. Information on potting cements which can be used compatibly with ceramic wire is included. 19 pages. Secon Metals Corp., 7 Intervale St., White Plains, N.Y.

Print No. Ins. 226 on Reader Service Card

New Marker and Sign Catalog

A new catalog provides complete

information on electrical and pipe markers, safety and identification signs, numerals, and letters printed on waterproof vinyl cloth furnished on quick-release dispensing cards and backed with an instant-stick adhesive. The non-conductive electrical markers are listed in three styles. 24 pages. North Shore Nameplate, a division of Anodyne Inc., 214-27 Northern Blvd., Bayside 61, N.Y.

Print No. Ins. 227 on Reader Service Card

Brochure on Coaxial Cable

New brochure illustrates and describes complicated shapes and configurations of aluminum sheathed air dielectric coaxial cable for use in spacecraft, radar, electronics, and the communication industry. Data on sizes and lengths, connectors, test facilities, and applications is also provided. 4 pages. American Tube Bending Co., Electronics Div., P. O. Box 1841, 5 Lawrence St., New Haven 8, Conn.

Print No. Ins. 228 on Reader Service Card

Manual on Electro-Sealing

New manual AA details basic steps and applications for electro-sealing, a process of hermetically sealing electrical, electronic, and mechanical components and assemblies. Electro-Seal Corp., 946A North Ave., Des Plaines, Ill.

Print No. Ins. 229 on Reader Service Card

Folder on Industrial X-ray Unit

New folder describes a compact industrial x-ray unit for inspecting the grain structures of plastics and many other materials and the internal motion of covered or sealed mechanisms and parts. 2 pages. Universal X-Ray Products Inc., 1140 N. Western Ave., Chicago, 22.

Print No. Ins. 230 on Reader Service Card

Infrared Sections Catalog

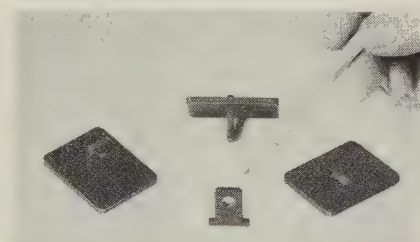
New infrared sections catalog 103 gives full information on low-cost infrared do-it-yourself oven components incorporating G-30 type infrared lamps. Advantages, assembly, and heat control are discussed. 2 pages. Fostoria Corp., Infrared Div., Dept. 45, Fostoria, Ohio.

Print No. Ins. 231 on Reader Service Card

Stamping Cuts Cost Of Insulation Parts

Punching blank space barriers from "Taylorite" vulcanized fibre sheet (Taylor Fibre Co.), rather than by molding, dropped tooling costs from an estimated \$1500 (single-cavity mold) to \$300 (punching dies) for Walker Electrical Co., Atlanta, Ga., an I-T-E Circuit Breaker Co. subsidiary. Walker uses the punched and assembled barriers in new, unusually compact lighting panel-boards incorporating new EQB bolted-type circuit breakers. The barriers meet UL requirements for insulators separating branch circuit connecting straps, when the breaker is provided for but is not needed at time of panel-board installation.

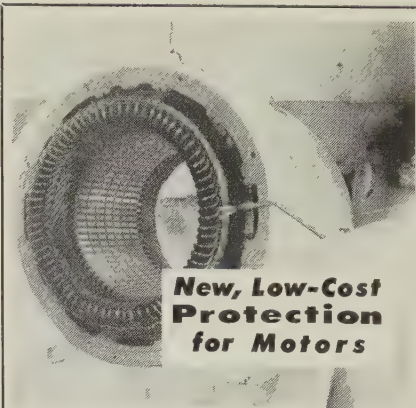
The blank space barrier is assembled by Walker from two stamped pieces. Piece in foreground is force-



fitted through the slot in the second piece (at right) producing a rigid, high-strength assembly as shown at left and top. Ability to meet the design requirements by assembling flat pieces not only cuts tooling costs but also permits the round screw hole shown, as against a slot needed when molding. The round screw hole assures better positioning of the barrier, even in the event of an improperly tightened mounting screw.

Experimental Timing Code Added to WWV Broadcasts

To aid in providing a standard timing technique, an experimental code is now being transmitted by the National Bureau of Standards as part of its standard frequency broadcasts over station WWV. The code is expected to provide a standard timing basis for experiments carried on simultaneously at widely separated locations.



Here's a new, low-cost epoxy resin system for protecting large electrical equipment against severe environments. Epoxylite® #213 Motor Seal. Spray it on: let it dry!

Check these features against the material you are now using. Then ask: "Wouldn't Motor Seal do a better job at lower cost?"

✓ Epoxylite #213 is an epoxy-based formulation, offering the outstanding chemical and solvent resistance inherent in the epoxy resins. It provides excellent protection against occasional splashing by acids and alkalis, water washdowns, mild corrosive fumes, etc. . . . the kind of abuse that rapidly destroys conventional insulation.

✓ Low in cost, the #213 can be applied in 3 coats in 90 minutes total elapsed time, including bakes!

✓ No special equipment required for application.

✓ Bake minutes at conventional varnish curing temperatures for fast processing . . . or airdry overnight if there's no hurry.

If you're interested in offering your customers Epoxylite protection . . . using the epoxies to do a better job at a lower cost . . . write today for complete information on Epoxylite #213, Motor Seal, the new moisture-proof, chemical-resistant motor protection that can be applied in minutes. For the information, write or phone:

THE EPOXYLITE CORPORATION

P. O. Box 3397
South El Monte, California
Cumberland 3-8231

Print Ins. 50 on Reader Service Card

Industry News

Precision Circuits Inc., manufacturer of printed wiring boards and devices, has expanded its facilities with the addition of a new 22,750 sq. ft. plant in New Rochelle, N.Y.

The boards of directors of *Temco Aircraft Corp.* and *Ling-Altec Electronics Inc.*, have approved a proposal to submit to the stockholders of both companies a plan for the merger of the businesses of Temco and Ling-Altec with the surviving company being known as *Ling-Temco Electronics Inc.*

Epoxy Products, a Div. of *Joseph Waldman & Sons*, Irvington, N.J., manufacturer of pre-formed epoxy resin formulations for insulation applications, has appointed the following sales representatives: *E. J. Foley Associates*, Scottsdale, Ariz., *The National Co.*, Seattle, Wash., *Design & Sales Engineers*, St. Louis, *R. Topal Co.*, New York City.

Antenna & Radome Research Associates, Westbury, N.Y., has moved to a new two-story plant containing 6300 sq. ft.

Acme Resin Corp., Chicago diallyl phthalate molding compound producer, has increased its manufacturing space by some 40% with the addition of new facilities.

The *Light & Power Utilities Corp.*, manufacturer of lighting fixtures, has officially opened its new \$600,000 plant at Olive Branch, Miss.

Kraloy Plastic Pipe Co. Inc., has opened new general offices and manufacturing facilities in Santa Ana, Calif. In Dallas, the company has opened a new district office and warehouse. Polyvinyl chloride pipe and electrical conduit make up the bulk of the production.

Metachem Resins Corp., Cranston, R.I., has formed the *Mereco Products Div.* to handle all epoxy and other allied compounded resin products previously manufactured by Metachem Resins Corp. for the electrical and electronics industry.

The *Special Tube Operations* of *Sylvania Electric Products Inc.* has

become part of *Sylvania Electronic Tubes*, a major division of the company. In addition to headquarters, a microwave components laboratory and a microwave physics laboratory at Mountain View, Calif., Sylvania's Special Tube Operations has a manufacturing plant at Williamsport, Pa.

Sylvania Electric Products Inc. has purchased a "substantial part" of the half-interest of *Corning Glass Works* in *Sylvania-Corning Nuclear Corp.* which is engaged in research, development, and production of fuels for nuclear reactors. SYLCOR headquarters and laboratories are in Bay-side, N.Y., and its production plant is in Hicksville, N.Y.

The *H. I. Thompson Fiber Glass Co.*, *Blackwood's Div.*, Los Angeles, has been appointed exclusive distributor in 11 western states for the infusible urethane foam systems and urethane coatings produced by the *Carwin Co.*, North Haven, Conn.

Philco Corp. has established a Special Products Operations in its Lansdale Div. (Lansdale, Pa.) to manufacture and market microwave components and infrared devices.

The *Connecticut Hard Rubber Co.*, New Haven, Conn., fabricator of silicone rubber products, has arranged to buy the assets of *California Rubber Products Inc.*, Torrance, Cal. It will be operated as a separate division of CHR.

The *Hainge Co. Inc.*, Houston, Texas, has been appointed manufacturer's representative in the Southwest for the vacuum and press equipment of *F. J. Stokes Co.*, Philadelphia.

Atlantic Research Corp., Alexandria, Va., has acquired *Northeastern Engineering Inc.*, Manchester, N.H., electronics manufacturer.

Physical Sciences Corp., Pasadena, Cal., an affiliate of *Packard-Bell Electronics*, has appointed *H. I. Thompson Fiber Glass Co.*, *Blackwood's Div.*, distributor of its high temperature wires, connectors, and potting compounds.

Egloff & Graper Inc., Los Angeles,

has been named sales representative in California for environmental chambers and low temperature freezers made by *Webber Manufacturing Co. Inc.*, Indianapolis.

E. V. Roberts & Associates, Los Angeles, is now distributing polyester resins in California, Arizona, and Mexico for *Celanese Corp. of America*, New York City.

The *N. S. Baer Co.*, Hillside, N.J., electrical insulation fabricator, has been sold by the founder to four of its executives. They are Peter J. Stec, president, Siegfried W. Nette, vice president of sales, Howard B. Baldwin, vice president of manufacturing, and Walter F. Oelschlaeger, secretary and treasurer. There will be no changes in name, personnel, products, or services.

The environmental test facilities of *Wiggins Connectors*, Los Angeles, have been expanded to handle all phases of aero-space testing for other manufacturers as well as for its own connectors for electronic and other systems.

A \$750,000 multi-color anodizing



and etching facility is being built in Miami, Fla., by *Anodyne Inc.*

New plant facilities, including additional treating and press equipment, are being added to the laminated plastic manufacturing and fabricating facilities of the *Continental-Diamond Fibre Corp.*, a subsidiary of *The Budd Co.*, in Newark, Del., at a cost of \$1,250,000.

Hooker Chemical Corp., Niagara Falls, N.Y., plans to build a multi-million dollar plant near South Shore, Ky., to produce synthetic phenol.

Designers for Industry Inc., Cleveland research and development firm, is celebrating its 25th year in business.

Haveg Industries Inc. has completed new laboratory facilities at its Taunton (Mass.) plant for material,

process, and application developments of plastics, elastomers, and ceramoplastics through chemical investigation, compounding, fabrication, and testing.

New facilities to be constructed at the *Oak Ridge National Laboratory*, Oak Ridge, Tenn., include a high radiation level examination laboratory, a radioisotope development laboratory, and a new accelerator building.

The Chicago branch operation of the *Panelyte Div., St. Regis Paper Co.*, producer of plastic laminates for electronics and other uses, has moved to a new warehouse and sales office in Skokie, Ill.

Whirlpool Corp., St. Joseph, Mich., has formed a refrigeration products division. John Platts has been named vice president of the new division and will supervise plants at St. Paul, Minn., and Evansville, Ind. Kenneth C. Williams, formerly assistant general manager of the Evansville plant, has replaced Platt there as general manager.

"Teflon" 100 fluorocarbon film

made by *Dupont* is now stocked for distribution in 11 western states by *R. S. Hughes Co. Inc.*, Los Angeles.

Vernitron Corp., producer of servo components, has moved its executive and research and development offices to new quarters in Long Island, N.Y. Engineering and manufacturing operations continue at Torrance, Cal.

Telex Inc., St. Paul, Minn., has purchased *Aemco Inc.*, Mankato, Minn. Both produce electrical and electronic components.

The *Sprague Electric Co.*, North Adams, Mass., and the *Telegraph Condenser Co., Ltd.* of Great Britain, both leading capacitor manufacturers, have agreed to exchange research, development, and manufacturing know-how for the next 21 years.

Hysol Corp., Olean, N.Y., manufacturer of epoxy resin compounds, is expanding its manufacturing and laboratory work areas by one-third.

The *Electro Nuclear Systems Corp.* has been formed in Minneapolis, Minn., to manufacture advanced systems and equipment for industry and government.

Vulcan Electric Distributors, Birmingham, Ala., has been named by *Formica Corp.*, Cincinnati, a subsidiary of *American Cyanamid Co.*, to fabricate and distribute its laminated plastics.

"Teflon" extruded and wrapped wire and multi-conductor Teflon cables manufactured by the *Philadelphia Insulated Wire Co.* for use in the electronic, electrical, airframe, missile, and allied industries are now available in 11 western states through the *R. S. Hughes Co. Inc.*, Los Angeles.

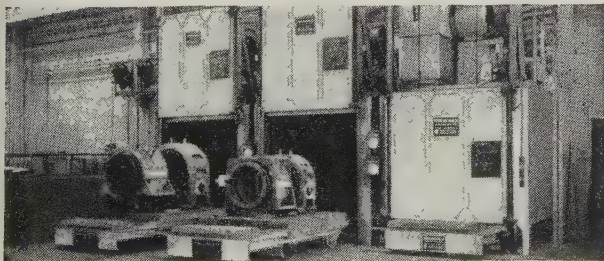
The *National Bureau of Standards* plans to begin work this fall on site development and construction of the first three buildings of its new laboratories at Gaithersburg, Md. The first of 20 buildings to be constructed in a total relocation program are an engineering mechanics laboratory, a radiation physics laboratory, and the power plant.

Commercial Plastics & Supply Corp., New York City, has opened a sales and service branch and warehouse in New Haven, Conn.

STANDARD OR
SPECIALLY
DESIGNED

YOUNG
BROTHERS
OVENS

for dependable, economical
BAKING and DRYING in the
ELECTRICAL INDUSTRY



Car-Bottom Type Stator Baking Ovens

The specialized knowledge gained in over 60 years of experience and in thousands of installations are available to meet your particular needs in Varnish Baking — Wire Enameling — Rubber and Plastic Curing, Paint and Enamel Baking — Glass Annealing — Service Shop Ovens. Young Brothers Batch or Conveyor Ovens will improve your product . . . reduce your costs. Write for New Bulletin 157.

YOUNG BROTHERS COMPANY

1874 Columbus Road • Cleveland 13, Ohio



Print Ins. 51 on Reader Service Card



FOCUS ON MYSTIK BRAND® TAPES

Take your problems to tape headquarters . . . Mystik. Here, in our full line of self-stik Mystik Brand Tapes and specialties, you'll find color tapes that code, identify, decorate . . . waterproof tapes that seal and protect . . . super strength tapes that perform heavy duty banding operations . . . hi-low temperature tapes that withstand the most severe conditions. For full information, write:



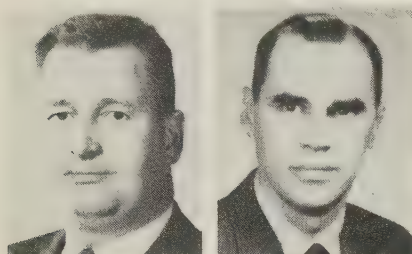
Mystik Adhesive Products, Inc.
2635 N. Kildare Ave., Chicago 39

Print Ins. 52 on Reader Service Card

People in the News

George Hardike, previously with the Diamond Motor Truck Co. and Standard Transformer Co., has been appointed director of manufacturing for John E. Fast & Co., Chicago capacitor and electronic parts manufacturer.

Robert L. Sell has been named assistant vice president of Telex Inc., St. Paul, Minn. electronics company. He will continue as director of engineering. *Harold G. Edwards Jr.* has joined Telex as manager of manufacturing.

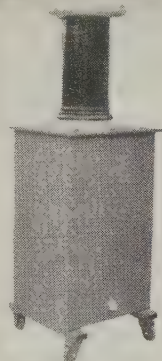


R. L. Sell

H. G. Edwards

150 KV RMS TESTING TRANSFORMER

150 KV rms testing transformer for combination Dielectric Test Set and Corona Level Test Set (on casters for mobility). Unit is corona-free to 75 KV rms. High voltage oil-filled bushing is corona-free to 150 KV rms. Capacity of testing transformer is 15 KVA (also available in larger capacities). Size is 30" X 36" X 83" high including the high voltage bushing, and the weight is 1100 pounds. Tank is filled with SF₆ gas dielectric for weight reduction (may be filled with transformer oil, if desired). High voltage bushing is 30" above top of tank.



Control cabinet for this high voltage section (not shown) contains all safety and convenience controls and meters, including a continuously adjustable output control to enable setting output anywhere from zero to full voltage.

APPLICATIONS: For Dielectric Testing in accordance with ASTM standards, Corona Testing, Research in connection with general missile program. For testing ceramic bushings, cable components, apparatus and insulation in general.

Ask for more information, now

Peschel Electronics, Inc.

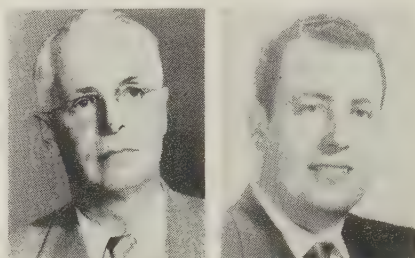
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Towners

Patterson, N.Y.

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Leland E. Wells, former director of engineering, has been promoted to vice president, engineering, of Exide Industrial Div. of The Electric Storage Battery Co., Philadelphia.



L. E. Wells

Sidney Fisch

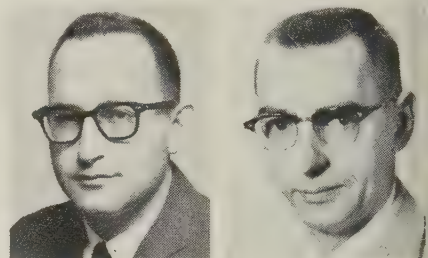
Sidney Fisch has been appointed chief engineer of the Essex Electronics Div., Nytronics Inc., Berkeley Heights, N.J. manufacturer of delay lines, coils, and R. F. components.

In the coatings and adhesives department of The Borden Chemical Co., New York, *Seymour D. Kirsch* has been appointed development manager, *James H. Christopher Jr.* has been named sales manager, and *Robert R. Munsell* has been appointed Northeast regional sales manager. In the resins and chemicals department, *Thomas L. Trafford* has been named engineering manager, and *Gene R. Foust* and *Don F. Hillmer* have both been named sales service representatives. In the Resinite department, *Allan W. Stephens* has been transferred to the Western sales organization. In the polycyco-monomer department, *William Edward Driscoll* has been named Midwest district sales manager, *John C. Becker Jr.* has been appointed assistant technical service manager, and *Nick Mechaes*, *Edward F. Wezowicz*, and *Gilbert L. Hembree* have all been named technical sales representatives.

At the Richardson Co., Melrose Park, Ill., manufacturer of plastic and rubber products, *Ramon A. Mulholland* has been named manager of the commercial development department.

The Epoxy Products Div., Joseph Waldman & Sons, Irvington, N.J., has appointed *Samuel Ringel* marketing

manager. He formerly was a market development engineer with the Rogers Corp., manufacturer of electrical insulation, plastics, and specialty materials.

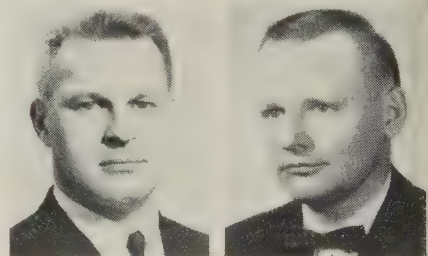


S. Ringel

C. Disser

Charles J. Disser, former chief electrical engineer and electro-acoustic engineer for Telex Inc., St. Paul hearing aid firm, has joined General Magnetics Inc., Minneapolis, as senior electrical engineer.

J. T. Simmons, formerly plant manager for the Ossining Div., Hudson Wire Co., has been named division general manager.



J. T. Simmons

W. A. Gammel

Walter A. Gammel Sr., formerly general manager of Automatic Process Control Inc., has joined National Connector Corp., Minneapolis, Minn., as director of marketing.

John J. Delaney and *Mario B. Rizzo* have been appointed sales engineers by Taylor Fibre Co., Norristown, Pa. Delaney, in Taylor's product development group since 1956, will serve accounts in Philadelphia, Delaware, and Maryland. Rizzo, previously a sales engineer in the Chicago area for Spaulding Fibre Co., will be working in Chicago and Northern Illinois.

Ling-Altec Electronics Inc., Anaheim, Cal., has appointed *Robert F. Martin* vice president of manufacturing.

ing, named *Edward P. Klein* manager of systems engineering, and made *Paul S. Goodwin* chief engineer of Ling Electronics Div.

Three molding compound sales appointments have been announced by the Plastics and Coal Chemicals Div., Allied Chemical Corp. *Eugene B. Hilker* will sell in the Detroit area; *Edward A. Jeffreys Jr.* in southeastern U.S.; and *John F. Nelson* in the Chicago area.

Shawinigan Resins Corp. recently presented *George O. Morrison*, the discoverer of "Formvar," polyvinyl formal resin, with an honorary scroll at a testimonial dinner in New York to commemorate his 41 years in the chemical and electrical industries. Shown presenting the scroll to Morri-



son is *W. Roy Elliot*, vice president and general manager of Shawinigan. Looking on are (left to right) *Murray M. Sprung*, General Electric Co.; *Harry L. Saums*, Anaconda Wire and Cable Co.; and *Norman J. George*, P. D. George Co.

The Specialty Products Div., Riegel Paper Corp., coated electronic board producer, has appointed *John E. Griffith* technical industrial salesman. Griffith formerly was technical assistant to the company's coating department superintendent.

Donald S. Elkort, formerly an associate project engineer with Microwave Electronics Div., Sperry Gyroscope Co., has joined Narda Microwave Corp., Mineola, L.I., as a microwave engineer.

Alfred Bersted, a pioneer in small electrical household appliances, has been elected president of the McGraw-Edison Co., succeeding *Max McGraw* who had held the post for 60 years. McGraw becomes chairman of a newly formed executive committee.

Robert A. Loddengaard has joined Servo Corp. of America, Hicksville, L.I., N.Y., electronics firm, as servo instruments section manager, Industrial Products Engineering.

NEW PRECISION TAPES SOLVE ELECTRICAL INDUSTRY PROBLEMS

Solve insulating, bonding problems with SCHJELBOND THERMOPLASTIC TAPES

Schjeldahl tapes combine an extremely strong bond with high dielectric strength. Manufactured to close dimensional tolerances, and with high electrical purity, they meet the most exacting standards.

SCHJELBOND 100 — .0025" thick Polyester dry strip adhesive **without backing.**

SCHJELBOND 300 — "Mylar"* backing, adhesive coated on **one side.**

SCHJELBOND 400 — "Mylar" backing, adhesive coated on **both sides.**

(Schjeldahl 300 and 400 available with precise adhesive thicknesses from .0002-in. to .003-in., on .005-in. to .010-in. "Mylar".)

DIELECTRIC STRENGTH — "Mylar" rated at 4000 volts/mil.

BONDS — "Mylar", iron, steel, copper, glass, aluminum, wood, paper, cotton, silk, linen, nylon, wood fabrics, phenolics and ferrites.

SPECIAL LAMINATIONS, "Mylar" to "Mylar," are available.

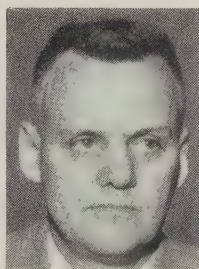
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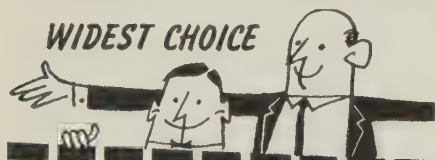
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Distributors' stocks in principal cities.

Write today for file folder including product data sheets and samples.

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Dates to Circle

Meeting and Convention Notices

Aug. 8-12 . . . AIEE, Pacific General Meeting, El Cortez Hotel, San Diego, Cal.

Aug. 18-19 . . . Electronic Packaging Symposium, University of Colorado, Boulder, Colo.

Aug. 23-26 . . . WESCON, Ambassador Hotel and Los Angeles Memorial Sports Arena, Los Angeles, Cal.

Sept. 7-8 . . . EIA, Second Conference on Value Engineering, Disneyland Hotel, Anaheim, Cal.

Sept. 7-9 . . . IRE, Joint Automatic Control Conference, MIT, Cambridge, Mass.

Sept. 13-16 . . . EIA, Fall Conference, French Lick, Ind.

Sept. 14-16 . . . AIEE-ASME, Engineering Management Conference, Morrison Hotel, Chicago.

Sept. 15-17 . . . EIA, Upper Midwest Electronic Conference, Minneapolis, Minn.

Sept. 19-22 . . . IRE, Space Electronics and Telemetry Convention and Symposium, Shoreham Hotel, Washington, D.C.

Sept. 21-22 . . . IRE, Industrial Elect. Symposium, Sheraton Cleveland Hotel, Cleveland, Ohio.

Sept. 21-23 . . . AIEE-ASME, National Power Conference, Bellevue-Stratford Hotel, Philadelphia, Pa.

Sept. 23-Oct. 1 . . . English Domestic Electrical Apparatus Exhibition, Electrical Fairs Ltd., Alexandra Palace, London.

Sept. 26-28 . . . Standards Engineers Society, 9th National Convention, Pittsburgh Hilton Hotel, Pittsburgh, Pa.

Sept. 26-29 . . . American Welding Society, National Fall Meeting, Hotel Penn-Sheraton, Pittsburgh, Pa.

Sept. 28-30 (Tentative) . . . Canadian Elec-

trical Manufacturers Assn., 16th Annual Meeting, Sheraton Brock Hotel, Niagara Falls, Canada.

Oct. 3-5 . . . IRE, Sixth National Communications Symposium, Hotel Utica and Utica Memorial Auditorium, Utica, N.Y.

Oct. 3-7 . . . 21st Southern Textile Exposition, Textile Hall Corp., Textile Hall, Greenville, S.C.

Oct. 9-13 . . . Electrochemical Society Meeting, Shamrock Hotel, Houston, Tex.

Oct. 9-14 . . . AIEE, Fall General Meeting, Morrison Hotel, Chicago.

Oct. 10-12 . . . National Electronics Conference, sponsored by AIEE, IRE, and Illinois Institute of Technology, Hotel Sherman, Chicago.

Oct. 13-14 . . . SPI, 16th Annual New England Section Conference, Wentworth by the Sea, Portsmouth, N.H.

Oct. 17-19 . . . Conference on Electrical Insulation, National Research Council—National Academy of Sciences, National Bureau of Standards and Shoreham Hotel, Washington, D.C.

Oct. 19-21 . . . IRE, Symposium on Space Navigation, Deshler-Hilton Hotel, Columbus, Ohio.

Oct. 24-26 . . . IRE, East Coast Conference on Aeronautics and Navigational Electronics, Baltimore, Md.

Oct. 27-29 . . . IRE, Electron Devices Meeting, Hotel Shoreham, Washington, D.C.

Oct. 31-Nov. 2 . . . IRE, Radio Fall Meeting, Hotel Syracuse, Syracuse, N.Y.

Oct. 31-Nov. 4 . . . IEC, General Meeting, New Delhi, India.

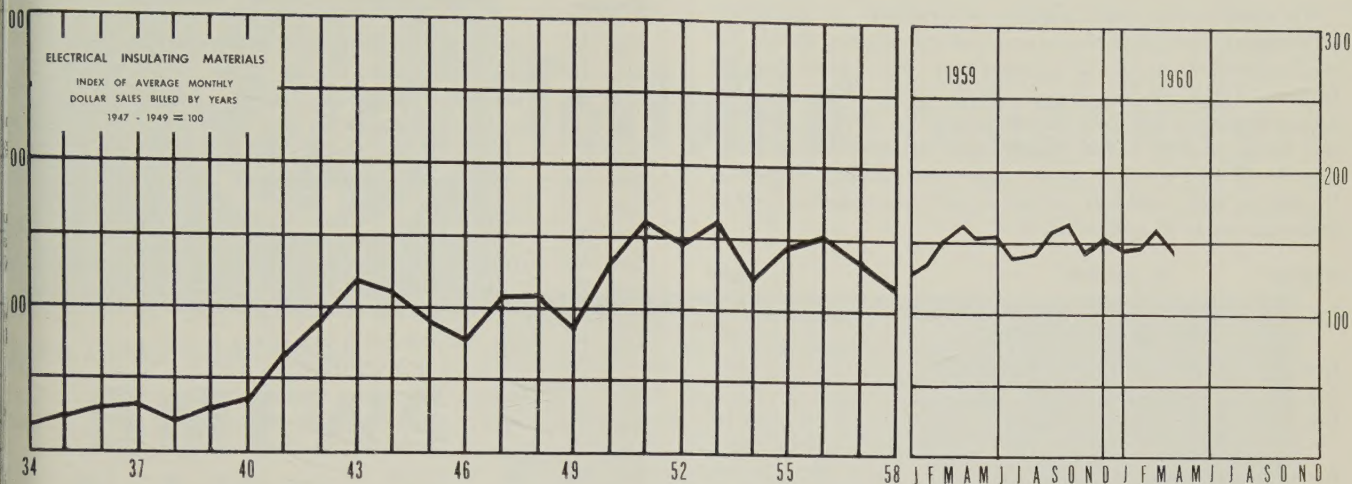
Dec. 5-8 . . . Third National Conference on the Application of Electrical Insulation, Conrad Hilton Hotel, Chicago.

Abbreviations Used in Notices

AIEE —American Institute of Electrical Engineers
ASTM —American Society for Testing Materials
ASME —American Society of Mechanical Engineers
ASA —American Standards Assn.
IRE —Institute of Radio Engineers
EIA —Electronic Industries Assn.

NEMA —National Electrical Manufacturers Assn.
NISA —National Industrial Service Assn.
SPE —Society of Plastics Engineers
SPI —Society of the Plastics Industry
WEMA —Western Electronic Manufacturers Assn.

NEMA Electrical Insulation Index



Index series	140	168	166
Apr. '60 point change from other mos.	—28	—26	
Apr. '60 % change from other months	—17	—16	

Index is based on 1947-1949 average month, inclusive=100

Published through the courtesy of the National Electrical Manufacturers Association

Materials Used in Electrical Insulation Index

Industrial Laminated Products

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Varnished Fabric and Paper

Vulcanized Fibre

Varnished Tubing and Saturated Sleeving (From May, 1952)

Speed Tying Operations!

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- ★ Cheaper than String
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NO KNOTS TO TIE!

Cut your tying time in half! Hanscom-Ties are the fast, sure way to bundle wires, cords, coils, etc. Nothing to tie. Just wrap 'em around and twist. For temporary or semi-permanent holding. Available in cut lengths 1" to 24" and on spools — bright colors or printed. Prices from 26¢ per thousand. WRITE FOR SAMPLES and TRY 'EM YOURSELF.

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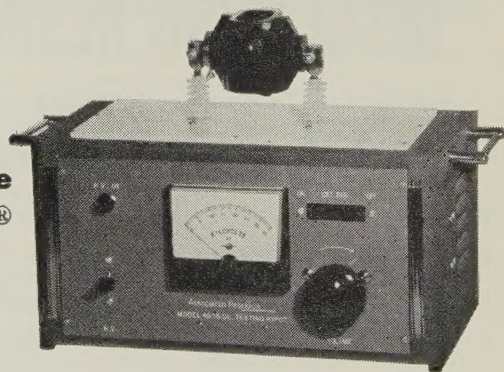


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On-the-Spot Dielectric Strength Measurements

Portable
HYPOT®
Model
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Insulating Oils Tested to ASTM Specifications

Complete Catalog

Data on the full line of ARI instruments for dielectric strength, resistance and other measurements.



Testing of insulating oils at the point of application, as well as in the laboratory, is made possible by this compact HYPOT® Tester, weighing only 42 pounds.

The test potential is adjustable from 0 to 35 kv a-c, at 2 kva output rating. Operation from 110 v, 50/60 c line. Motor-driven automatic rate of rise control optional.

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	Belden Manufacturing Co.	37
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Marblette's E Series epoxy formulations for
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- available as flexible or rigid materials
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Write, wire, or phone today for Marblette's new electrical selector chart, with complete listings of properties and detailed information on uses of all Maraset E Series resins:

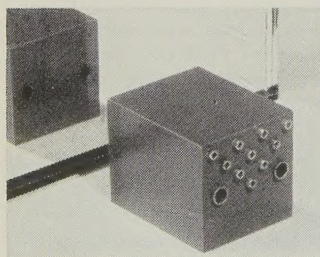


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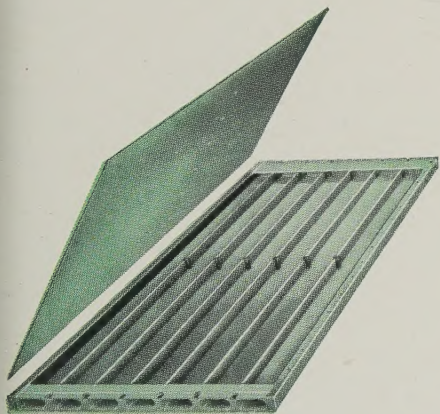
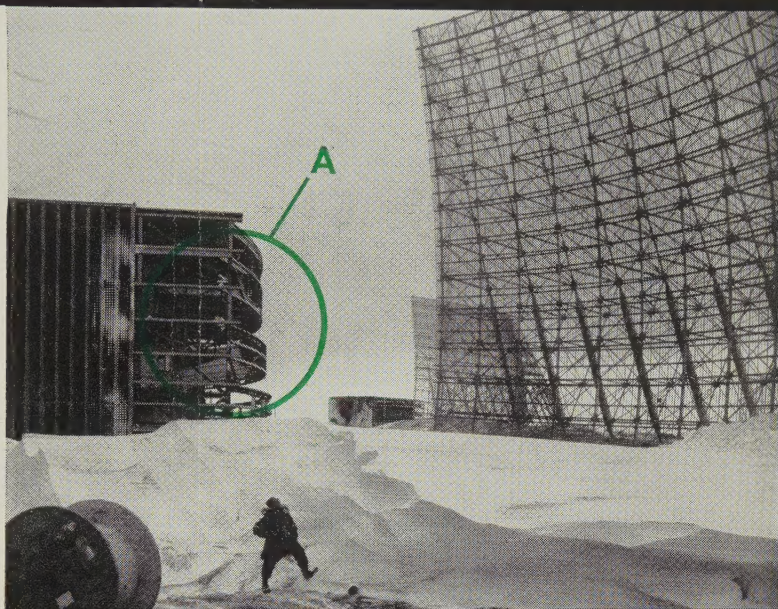


Textolite®/reliability

Unique Arctic application...

BMEWS reliability can mean survival...

 **Textolite®** 11546
helps insure that reliability



Radar Window of G-E TEXTOLITE 11546 protects exposed feedhorns (A) while permitting transmission of radio frequency energy. Hot air continually blown through window cells prevents ice formation during sub-zero arctic weather.

Towering high over the Arctic wasteland, giant radar antennas like this one (each larger than a football field) form part of the surveillance radars for the U. S. Air Force's Ballistic Missile Early Warning System (BMEWS). Developed by G-E's Heavy Military Electronics Department for RCA, BMEWS prime contractor, these surveillance radars will be instrumental in providing approximately a fifteen minute warning in case of a missile attack across the northern polar region. The first of three BMEWS sites is nearing completion near Thule, Greenland.

So gigantic is this surveillance radar that feedhorns and other vital equipments are housed in separate scanner buildings. Protecting each feedhorn from the sub-zero arctic weather is a Deicer Panel Assembly or "radar window" fabricated from G-E TEXTOLITE 11546, a G-10, high IR, glass epoxy laminate.

Micarta Fabricators Inc., an independent Chicago fabricator, built the windows for the Andrew Corporation who had the overall responsibility for the feedhorn-window system. Andrew specified TEXTOLITE after conducting a development program to select the most suitable material consistent with low cost. Tests prove TEXTOLITE 11546 meets the rigorous electrical, mechanical and environmental (-70° to $+50^{\circ}$ F, temperature variations, winds up to 185 MPH) conditions inherent in the BMEWS project.

For information on 11546 or other G-E TEXTOLITE laminates for your particular application requirements write: Laminated Products Department, Section I-80, General Electric Company, Coshocton, Ohio.



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EXPAND BEN-HAR "1151"

and get as many as 4
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Now with one size of Ben-Har "1151" extruded silicone rubber fiberglass sleeving you can cover as many as four different sized applications. Ben-Har "1151" is so tough that it permits expansion of up to 400% increase in a.w.g. size without typical end fraying, coating fracture, etc. Easy assembly and snug fit over irregular knobs, terminals, and connectors are assured. Inventories can be greatly reduced because one size Ben-Har "1151" will do the job of several old style "dip coated" sleeving sizes.

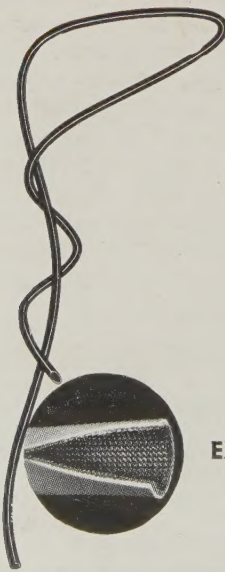
Here's another plus for Ben-Har "1151" — it's fingernail damage proof. Even the roughest handling in assembly can't cause nicks and breaks that increase production costs, lower production output.

Exclusive Extrusion Coating (pat. pend.) with the new super-tough **durasyll** silicone rubber makes Ben-Har "1151" superior to other Class "H" sleeveings in physical, mechanical and electrical properties. Every inch is inspected electronically, guaranteeing reliability never before possible.

Test this superior sleeving in any way that you wish.

Write for data sheet and samples in the size you customarily use.

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